IN TWO SECTIONS—SECTION ONE.

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Indexes for the previous 6 months will be found in the First number of July and the First number of January.

Books.—We will forward by express, at publisher's lowest rates, any book—scientific or otherwise—to any address in the United States or Canada. We would suggest to our patrons that to avoid the risk and expense consequent on sending us the money (we do not send books C. O. D.), that orders for books be sent us through the Purchasing Department of the American Express Company.

The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

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[NOTICE.]

Wrinkle Department, American Gas Institute.

WRINKLE DEPARTMENT, AMERICAN GAS INSTITUTE,
OFFICE OF EDITOR, GAS OFFICE BUILDING,
DETROIT MICH, March 12th, 1909.

To the Members, American Gas Institute: All members of the American Gas Institute are earnestly requested to forward contributions for the Wrinkle Department as soon as possible.

Your co-operation determines the success of the Department.

F. L. CROSS, Editor.

BRIEFLY TOLD.

OUR SEMI-CENTENNIAL ISSUE.—Our semi-centennial is now before you, and to our patrons we leave the determination as to whether or not we claimed anything too much for it in our advance notifications regarding its value. It was a huge undertaking, and we herewith wish to give our sincere thanks to those who so unselfishly and potently aided us in thus marking our entrance into the second half century of our existence. The complete edition, in two sections, goes to our subscribers without charge, and those who are desirous of securing extra copies should send in their orders immediately. Repeating our acknowledgments to the authors who so ably assisted us, we wish continued prosperity to the industry whose best aims it has for half a century been our duty to uphold.—A. M. CALLENDER & CO., Publishers.

EDUCATION AMONG GAS COMPANY EMPLOYEES.—That the workers in our present decade have and enjoy much greater opportunity than did those of its predecessor, and that its successor will behold a still further increase is evident at every glance on every hand. It may not be that we, individually or collectively, will reap a larger measure of this world's goods, but we undoubtedly will attain a higher mental plane through the ever increasing means of education which are being prepared or are in readiness for the avail of our students. Whether or not our material fortunes are sensibly improved by this state of affairs matters little, since it is axiomatic that those who increase their knowledge are beyond a doubt growing in mental power. In the realm of higher education for the young gas man the present most enthusing inspiration has its beginning in the proposed memorial to the late Sir George Livesey, which has most typically and beautifully taken the form of the endowing of a class, the chair for which will be within the walls of that sterling British institution of learning, the Leeds University. Nearer home we have the Practical Class of the American Gas Institute, which grows in value and importance each year, and also in usefulness, since this year it has a larger enrollment than any heretofore recorded. Again, we have the effective work which is going quietly on under the auspices of the Michigan Gas Association. Again, we have the increasing good work that is being done along educational lines by the Bureau of Information of the American Gas Institute. This work, of course, is a trifle beyond that which may be availed of by beginners; but many an old one

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SMITHSONIAN DEPOSIT.

has been advantaged by it. In fact, Editor Baehr and his fellows, in their conduct of this admirable work, have hardly been fair to themselves, in that to do what they have so continuously done must have required the expenditure of many, many hours of thought and research and original experimenting. Even those who think seldom of such things, and their cost in one way or another, if their examination were ever so superficial, surely must have been surprised at the length, depth and breadth of the study which was given to the subjects or queries, as shown in the answers thereto. Several colleges are debating the good practice of establishing a gas engineering course in their lists, and some have gone to the point of teaching the gas engine as a source and instrument of power. Others, too, are on the verge of recognizing gas engineering as an important and separate branch of engineering economics. Again, the present day gas apprentice, be his position ever so lowly, has the means of becoming more proficient in his work right close at hand, and without cost. This reference goes to the ordinary plan of company meetings of employees. At these meetings, which are largely "experience sessions," directed by the engineer or manager of the particular company, the real marrow of the bone under contention is extracted. Still another field, and, strange-to-say, it is the one that has so far received the least attention, has to do with educational literature issued by manufacturing companies. One of the latest efforts along these lines is a booklet entitled "Instructions for Handling Recuperator Benches," which is issued by "The Parker-Russell Mining and Manufacturing Company." We commend this treatise to those supplying the trade as a valuable and praiseworthy method of advertising. It is the aim of the JOURNAL to be of value as an educational, as well as a scientific publication, and it welcomes any work along these lines as a boon to the industry.—"SPECTATOR."

CURRENT MENTION.—

FRIDAY week we had the great pleasure of a visit from that greatest of all living gas men—the Hon. Thomas Newbigging, of Manchester. The well-loved veteran was as nimble of stride, hearty of grip, resonant of voice and beaming of demeanor, as though not more than 50 years had been his portion in the allotment of days that are done. His visit to America, too, was strictly in line with work, he having accepted a retainer to counsel with Mr. Pearson, of Toronto, over the best type of holder to be constructed on the great new plant of the Consumers Gas Company, of that city. The veteran sailed for home the morning of the 3d inst.

MR. J. MCGRAW, Manager of the new business division of the Roanoke (Va.) Gas and Water Company, writing under date of the 14th inst., says: "We beg to report that owing to the increase in our gas sales during the past year, we are now obliged to at once increase the size of our plant throughout, in order to handle the same."

DR. A. C. HUMPHREYS, President of the Stevens Institute of Technology, sailed for Europe Saturday last. He will return early in September.

THE Town Council and Burgess of the borough of Swoyerville have assented to the petition of the proprietors of the Wyoming Valley Gas Company, of Wilkes-Barre, Pa., for the right to lay pipes for the distribution of gas in the place named. This is the first of the many extensions of mains that the Wyoming Valley Company has, with the common sense that has marked its management under its new control, determined to make.

THE pronounced upward movement in the shares of the Washington (D. C.) Gas Light Company seems at last underway. An advance in it of 10 points for the week has been recorded—from $66.75 to $76.87 per share. On this break the stock should go to $100 per share, or $500 on the par of $100.

THE Waterbury (Conn.) Company is extending its service to the outlying borough of Waterville, and is now contemplating the taking in of two or more districts that are more than fair in promise of yielding paying patronage.

ON the 10th inst. stock certificates were distributed by the New Haven (Conn.) Company to the employees who have taken advantage of the workings of the profit-sharing plan that was started in April, 1907. The total number of shares thus issued footed up 551, parcelled out amongst 197 of the employees. Some of his Eastern contemporaries were inclined to smile at Mr. Nettleton when he advocated this plan, as far back as 1903; but the laugh now is altogether with him in the result.

"WELCOME to you, Mr. Aldrich." So writes a correspondent in Detroit, Mich., who also forwards the following clipping from the Spokane (Wash.) *Chronicle*, dated the 7th inst.: "W. A. Aldrich, for years the successful Manager of the Spokane Falls Gas Light Company, has been promoted again. From Spokane Mr. Aldrich went to the Coast, where he has been Manager of the Tacoma Gas Light Company. Now the latter plant has been sold to the Byllesby syndicate of Chicago. 'The new Company wanted me to remain; but the Dean Company, of Grand Rapids, Mich., would not permit it. I leave Tacoma to become Chief Engineer of their properties, after I have remained long enough to plan all the proposed extensions and improvements in the Tacoma service, especially in the North End. I think Tacomans fully appreciate what the future has in store for them. With the advent of the new railways the place is bound to grow in a manner that will even strain a lively mind. Spokane and Tacoma have remained side-by-side in increase of population for many years. During the next 5 years Spokane will not be able to realize the way Tacoma is growing. While I regret leaving Tacoma, I leave for a more profitable field. What investments I have here shall be allowed to remain, as some time I expect to make it my permanent home.'"

THE residents of that delightful old spot in New Jersey, known as Madison, and which to-day bears witness to one good that the late Deacon Daniel Drew did in his time, through the establishing there of a seminary (to be sure it bears his name), have decided that if gas is to be supplied at all it will be supplied from a municipal plant. It has been sustaining a municipal electric lighting plant, which, to tell the truth, does the best it can when trying to illuminate the streets by means of 16-candle power incandescent lamps. And its best in that line is not much. Well, some progress has been made anyway. If the burghers or burgesses or the like will not let foreigners (Morristown is the foreigner that wanted to send them gas) furnish gas in Madison, the next best thing is to have the burghers, etc., do the trick themselves; for certain it is the ordinary residents are extremely anxious to secure gas, if for fuel use only.

WITH great regret we chronicle the death of Mr. Charles A. Mack, well known to the Eastern gas fraternity as the representative of the Welsbach Company, of New England, whose demise occurred the morning of the 6th inst. Deceased was much esteemed, and his death is all the more regretted, in that he was stricken at an age that seemingly had a long view of useful working years ahead.

THE Gas Bench Construction Company is putting in new bench work in the plants of the Marquette County Gas and Electric Company, of Ishpeming, Mich; and of the Jackson (Mich.) Gas Light Company. It is also under contract to furnish the complete linings and checkerbrick for the new 7-foot 6-inch water gas set now being erected in the plant of the Houston (Tex.) Gas Company.

EARLY this month a canvass of the city of Baltimore, Md., was conducted by the Consolidated Gas, Electric Light and Power Company, of that city, with a view to determining how their gas customers stood in respect of the proposition that the Company distribute natural gas in the city, and under the following conditions:

First.—That natural gas will be furnished by the Consolidated Company at the price of 58 cents per 1,000 cubic feet for illuminating, 45 cents per 1,000 cubic feet for cooking, and 40 cents per 1,000 cubic feet for heating, gas engines, etc. The price for manufacturing gas not being named.

Second.—That the Governor of the State and Mayor of this city shall name 5 of the 18 Directors of the Company, and that the city shall receive 40 per cent. of any distribution of further net profits remaining to the Company after 4 per cent. has been paid on the common stock of the Company.

Third.—That the Seaboard Gas Company will convey the gas from the gas field of Virginia to the city of Baltimore, where it will be distributed by the Consolidated Gas Company.

The consumers of the Company were asked to vote on this proposition as a whole or singly. The ballot resulted as follows:

For natural gas as proposed	65,453
For natural gas, but not as proposed	564
Against the proposition	222
For the proposition, but with Public Utilities Commission.	145
For, but not at price named	160
For an independent company	2
For municipal ownership	1
Without names and addresses	19
Want more information	19

The total vote cast was 66,585, and of the voters possibly 25,000 were of the gender feminine. Secretary Cohn arranged for the conduction of this test, and the result must certainly be gratifying to his superiors and himself, in that it shows that the gas users of Baltimore, if they are to have natural gas, prefer to have the Consolidated Gas Company in sole charge of such distribution.

Oil Light Explosions.

[Prepared for the JOURNAL, by "R."]

In passing a dining hall recently I noticed that the front door was shattered and pieces of piping and the remnants of a tank could be seen, so I entered the place and was told about a kerosene lamp explosion. Of course numerous patterns of first-class, modern oil lamps are in use throughout the country, but there are also many designs of cheap and inferior oil light and tank combinations, and extremely dangerous oil and alcohol illuminating outfits. There are types of gasoline apparatus which ought to be condemned, and many other devices which should never have been allowed to go into operation. In the great demand for a brilliant light at a low cost, the public caterer, the store man, the office occupant and the householder, as well as the manufacturer of goods, seek to install a lighting system which will give satisfaction at a low cost. Inventors of brilliant illuminating devices have been obliged to consider the costs in every system, for the price thereof must be kept low, otherwise the other style of lighting device will be purchased. Consequently, the market is well provided with low-priced grades of oil illuminants. Often these oil lights are bright, and after a test the owner of the establishment allows the agent of the concern to install the oil lights and remove the gas or electric lights. It is done to save money; also, because the glib agent can talk well in explaining the advantages of the cent-an-hour oil outfit over the other kinds. It is not remarkable, therefore that, driven by competition, makers of oil illuminants often turn out a type of outfit necessarily risky because of the low price at which it must be sold.

As above remarked, there are many reputable builders of oil lights of up-to-date pattern who manufacture exceedingly superior and safe devices; but we are referring to the class of cheap oil illuminants, made to sell, and the construction of which is doubtful. The oil lights in question are almost always extremely brilliant so far as illumination is concerned, for brilliancy is considered the important factor. The bright light sells the goods.

The oil is consumed at the burners under pressure. It is turned into vapor in some outfits and the gases thus generated are brightly burned, an excellent principle, and, when properly carried out, a safe and effective light results; but inexperienced men seek to put in inexpensive vapor lights and an explosion often results. The mantle lights are fine when properly installed, but here again we find that dealers are compelled by competition to cut here-and-there to get a margin of profit and put in a cheap and dangerous substitute. As soon as I examined the blow-up in the dining room, shown in Fig. 1, I realized the cause. The oil tank was set to the wall, near the ceiling, back of the door. The tank was gilded and presented a very neat appearance. The light was good, the boss said, and the outfit looked well with the gilded pipes; but a plate was blown out of the tank, at *A*. I discovered blowholes and cracked lengths in the plate. I found places plugged with lead. One place was filled with clay and gilded over. I think that a second-hand tank had been repaired, gilded and worked off as new. To save in lead joints, some thin, inferior fiber packing was used. A good lamp was employed; but the rest of the outfit was poor.

The explosion was caused by the heat of the lamp expanding the joints and causing leakage, and the accumulated leakage finally produced sufficient vaporized oil gas to cause ignition. The flames reached the tank and the tank exploded. In a first-class outfit the joints in the pipes would have been securely constructed and the leakage would not have happened.

In another place the writer found the hall lamp post upset and the rail of the stairs broken. Some of the steps were lifted. The tank just below the stairs had exploded, at *B*. In this case the cause was said to be due to the carelessness of the servant, who was in the habit of going off leaving the light burning too high. I said nothing, but an examination of the outfit revealed other facts. The tank was poorly constructed of cheap sheet iron, carelessly riveted. There is no doubt the tank leaked and that the oil gathered and ignited, causing the explosion.

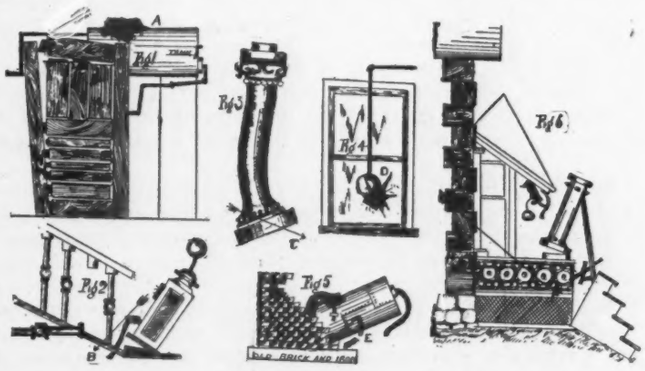
An odd result of an oil light outfit explosion is shown in Fig. 3. The post was constructed with wrought iron rods for the center, about which new concrete had been shaped and pressed, so as to make the regulation cement pillar. As the cement was still soft, an oil tank explosion in the basement below caused the post to spring, which was due to the upward pressure of the foundation at *C*.

Sometimes it is not the tank, but the poor grade of lamp that explodes, as at *D*, Fig. 4. In this case a broken window could be seen with the exploded lamp. The oil, which was burned on a mantle, was not of standard make, and bore no mark to indicate its manufacturer.

I found that all of the connections were of the very cheapest. In fact, I was able to spring any joint and so cause a leak. The metal connections were improperly set. The thread work of the unions was cast, instead of cut, and the threads failed to take hold, and cheap, clay-like stuff was used to pad up with. This material had baked, caked and cracked out. There were gaps in places where perfect joints should have prevailed. Of course, a combination of this kind should never have existed; but the housewife had accepted the word of a travelling oil light agent, had paid for the installation and forgot to ask names and addresses. The lamp itself exploded and did only local damage, as the inmates of the house were nearby and saturated the fire out with water.

I saw a pile of old brick and iron in a candy store cellar and noticed the nose of a tank protruding as at *E*, Fig. 5. This neglected lot of junk was all that was left of a cheap oil light burner and outfit. The fumes of the generated gases got "going wrong" one evening, and when one of the boys of the house went down with an oil lamp to investigate from whence came the odors of the escaping fumes, the fumes took fire and the boy was injured, the basement took fire, a lot of candy stock was destroyed and the fire department called out. Once more inferior and cheap work caused trouble.

Again, the porch of a beautiful house was demolished, as in Fig. 6, because of the upheaval of a gasoline tank at *F*, just below the porch floor.



The firemen reported that the blow-up was due to the carelessness of the man servant. The inspector of tanks of the district had reported that the tank was out of order; so it was, for it was out of order when installed. The rich man had been deceived, and he had paid full value for a cheap outfit. Anyone could see the defectiveness of this outfit. The plate metal was thin, the rivets too far apart, the whole affair shoddily designed and made.

This article is written for the purpose of warning persons against buying cheap oil lighting outfits advertised at sacrifice values. There are plenty of very good oil and gas outfits for sale at your local dealers. Let your home manufacturer install your outfit at his own price. It will pay. The country is flooded with circulars advertising cheap, easy to-run and perfectly safe outfits. Look out for them, for some of them are dangerous.

[CONTINUED FROM VOL. XC., JUNE 21, p. 1112.]

EIGHTH ANNUAL CONVENTION, WISCONSIN GAS ASSOCIATION.

HELD AT THE HOTEL PFISTER, MILWAUKEE, MAY 12-13, 1909.

FIRST DAY—MORNING SESSION.

The President said the next order on the programme was the reading of papers, and thereupon introduced Mr. W. C. Heinrichs (Decatur, Ills.), who read the following paper on

QUALITY OR PRICE, WHICH?

It's rare judgment that can properly differentiate between the good and bad and accurately determine when an article is cheap at the price asked. In other words, it's a wise man who can tell when he has a bargain.

A bargain has been defined as a transaction in which both sides are satisfied; a trade in which both sides are benefited. No man as a buyer ever got a bargain by getting more than he paid for; and no seller ever got a bargain by selling more in value than the price called for. That, however, is not generally regarded as the right definition. It's a question on which men disagree according to their understanding of the word "bargain." One man will buy a certain thing because it offers a lot for his money, regardless of the service it will render, and thinks he has a bargain. Another man will pay a lot more for a whole lot less goods, because he is buying for service, quality, dependability and not bulk. He knows he has a real bargain and sees the wisdom of paying a fair price for goods that will last long, rather than buying the kind at a low price that will last but a short time.

There are men who still believe it is economy to buy cheap goods and buy them often. Most buyers, however, realize that a dollar in value calls for a dollar in money, and think it is real economy to buy that kind—the sort that has quality and lasts, and does not require frequent repairing. This is a point that every manager and buyer for gas plants should take into consideration.

Goods having nothing to commend them but a low price will not return adequate service and must soon be repaired or replaced. To the original low price must then be added the interference in operation, the annoyance to the company or consumer and the expense of labor. In the end they are high priced and not low priced goods.

Perhaps the best example of this is shown in that class of goods which goes underground—the mains, services and their accompanying parts, as well as those that go in the house. If you buy this class of goods simply because of cheapness in price, you will awaken to a realization of the mistaken policy when they begin to call for repairs and replacing. The necessity of taking up pavement, digging into the ground, then replacing the earth and paving, is an expensive process which adds materially to the operating expenses, and the operating expense is the one thing that most managers wish to reduce.

Low cost in operation means larger dividends to the stockholders. And 'tis the stockholders and owners who must be satisfied with the consumer being pleased. It costs just as much to put cheap materials in the ground as it does those commanding a fair price, but it's much more expensive to keep them there. It would have been far cheaper to have paid twice the price of the cheap article and secured one that would not have necessitated the expense of replacing or repairing; but it takes this experience to prove whether this particular article was really dear or cheap at the initial price.

When the consumer is considered, there should never be any question about quality. Small leaks and mechanical defects in construction may go undetected for a long time and possibly increase the expense of gas to the family, besides endangering health and comfort. Even if it causes nothing more than annoyance to the consumer, that annoyance detracts from the good opinion in which the company may have been held in, or adds to the bad opinion which has existed.

Most consumers regard corporations with which they deal as things of evil and their natural enemies. As a rule, they are hunting a chance to use their "brogans," and once dissatisfied they remain eternally suspicious. They say nothing good of the company, but spread ill reports to its detriment. Every unjust impression growing out of these complaints is just that much of an obstacle to be removed when it comes to securing the business of the person who has been affected by the talk. It can truthfully be said of goods of quality and undeniable merit, even though they cost more, that they possess better material and better workmanship, which enable the workmen in an enlarged degree to do better work in the fitting. They will require less attention for repairs and are less liable to cause defects and consequently remove at once a cause for complaint that brings the company into disrepute with the consumer.

Every gas consumer wishes to market its product to the satisfaction of its consumers and with the least possible friction, but wants to do it at a profit. Just as the gas men want a fair profit for marketing their product the manufacturer wants a fair product for marketing his. It costs so much to make gas and it can be sold at a certain figure for profit—below that figure it cannot be sold profitably. The manufacturer knows just how much it costs to make an article of quality and knows it must be sold at a certain profit to keep up that quality. He knows, also, that the same article cannot be made just as good by a competitor using inferior material and cheaper labor.

As a rule, buyers are coming to the point where they place a higher estimate on quality and a lower estimate on price. They are realizing the false economy of being influenced by price and the true economy of being influenced by value and serviceability. Manufacturers who believe in the quality theory are to-day putting their names on goods and standing back of them. This is true in nearly every line of business.

In watches, clothing, shoes, furniture, the name of the maker becomes the guarantee to the buyer. He stands back of the retailer and brings himself right up to the consumer with the assurance that the goods are up to the representations of his salesmen or his advertisements.

It seems to me the part of shrewd business to use only the best there is when it comes to the construction of any public or semi-public institution. And it seems to me it would be the part of good business judgment to use only such goods as are guaranteed and backed by the name of the manufacturer on the same. If these goods fail to return reasonable service for the price charged, the source of their manufacture is easily traced by the name which appears thereon. It affords a chance for just complaint or friendly suggestion. Neither of these is offensive to the manufacturer. On the contrary, both are welcome. A just complaint is easily remedied, and a suggestion for overcoming some defect developed by local conditions affords the opportunity for correction, frequently the opportunity for an improvement in the goods.

Discussion.

The President—This interesting paper is before you for discussion. There is always a community of interest in trade, and the ordinary attitude of mind is this: The fellow giving the order is conferring a favor upon the fellow getting the order, and the recipient of the order is expected to say, "Thank you." Now, if a man wants a pair of shoes, and wants them badly, and there was not a shoe shop in Milwaukee, and he had to go all the way to Chicago or New York to get them, he would be hard pressed; wouldn't he? He says, "I want a pair of shoes. Here is a shoe shop. I will go in and get the shoes exactly that I want." When he gets them, paying a fair price for them, he says, "I am glad to have the opportunity of buying the shoes that I wanted, at a fair price; it is a benefit to me as well as it is to the other fellow." The shopkeeper says, "Thank you." It is really not a question of favoritism one way or the other, but it is a matter of mutual advantage. This principle applies to all other lines of business. A reference in my own address to it was somewhat on those lines; namely, the community of interest between the public service corporation, the gas company selling gas and the people buying it. And we cannot expect good goods at a "skin" price. If you expect an improvement in the quality of goods and a decrease (instead of an increase) in the price, we reach an absurdity. The demand for good service is the demand again in another form for good goods. Many of us, I fear, do not look upon the salesman in the right light. In point of fact, he has come to confer a favor upon you just as much as you confer a favor upon him. If he brings you a new stove or burner or new appliance of any kind, and shows you the superior merits of it, he has brought something of value to you, whether you buy or not; for he is educating and training you. These gentlemen come to help you give good service, to educate and assist you, and to keep you abreast of the times. Give the salesman an opportunity to explain the merits of his devices. It is distinctly to your advantage to do so, nor do I suggest you give him the opportunity to explain the particular demerits of somebody else's devices. As a rule that should not be done. Having examined an article and come to the conclusion that it is valuable, your next question naturally is, "Is it worth the money; is there not too much profit in it?" But you should not talk of a price at which the manufacturer cannot live. In that case you are not acting fairly to the seller. This paper is important; it is not simply a paper to be dismissed with thanks. It is the result of a lot of work, and it has a lot of meat. We would be glad to have it fully discussed.

Mr. Taylor—My experience in the small world in which I have lived is that the man who hunts for "bargains" from the salesman, and tries to "Jew" him down, gets the worst of it; whereas the man who gives his confidence to the salesman, receiving his confidence in return, will get a fair bargain, and the salesman will, as a rule, recommend his best goods at the lowest price. But the man who is continually trying to get a price lower than what is fair, to secure an extra 5 or 10 per cent., is going eventually to get the worst of it; for, in the first place, he gets the enmity of the salesman, and in the second place the salesman has to make the sale to hold his reputation. So, if the salesman is compelled to give that unfair additional 5 or 10

per cent. discount, the purchaser will get the cheapest article that can be offered.

Mr. Walker -The greatest fault I can find with Mr. Heinrichs' paper is the fact that he told the truth all the way through; he has not left an opening for anybody to argue with him, and it is pretty hard to controvert the truth with argument, especially when there is no chance to do so. The fact of it is, with regard to buying first-class articles for underground work especially for gas companies, you cannot buy cheap goods and put them underground profitably, for the simple reason they cost you twice as much in the end as good goods would. I think that most any gas company having had any experience in buying cheap goods will readily admit that statement. There have been, in my own experience, in times gone by, cases where works were built to sell. Here so-called "bargains" in underground goods were made, and later on it be came necessary to rip up and relay the entire service system, and all that class of work. The companies found out to their cost there was no bargain in buying that class of goods; and it often happened, by the time they had to rip the service out of the ground, the firm who sold the goods to the company was probably out of existence, and they had no guaranty. Even if the company found the maker's name on the goods (it frequently happened he was so ashamed of them that he would not put his name on them), it was often the case that he had gone out of business or was not responsible. For all this class of work the motto should be, the best goods at fair prices. I think Mr. Heinrichs' paper a very valuable one.

Mr. Parker—In my long experience as a salesman I never met a body of gentlemen so willing to give a salesman an audience as the gas people. I have had a varied experience in other lines, calling on different trades in earlier days, but cannot recall an instance in the last 12 or 15 years where, if a salesman exercised the judgment that should be exercised, he failed to get an audience with a gas man. The gas men have always been willing and ready to see what salesmen have to present, or what you have to advocate and to set forth. No set rules govern your salesmen or the buyer, but there are fundamental principles which both should follow, that are so well set forth in the paper, that no one can take issue with the author's conclusions.

The President—We have a gentleman who is perhaps as well posted on this matter as anyone in the room, I refer to Mr. Williamson, of Chicago, from whom we would be glad to hear.

Mr. Williamson—I did not have the pleasure of hearing the paper, as I came in just as the paper was about concluded, but I gathered from the remarks of the President, and what little of the paper I heard, the fact that you cannot get anything for nothing; you get what you pay for, nothing more. That is very true. Now, of course it is to the interest of every gas company to buy the best goods it can. One thing is important. Sometimes you have got to buy things that are not the best, simply because you want to use them temporarily. I do not want to combat the idea that we should buy the best for permanent use, but you will find at times it is necessary to put in apparatus temporarily to tide over an emergency, when it would not be wise to buy the best apparatus for such use. If you wanted a steam engine for 1 or 2 months' use only, you would not buy a first-class article, but would try to get a second-hand engine to tide you over your trouble. I am a great believer in buying the best you can get for permanent use, and always was a believer in the tradition that you cannot get something for nothing; that you get only what you pay for, whether it be in men or goods.

Mr. Kellum—I feel in discussing the benefits derived by gas companies in using good goods that another important point exists which should not be lost sight of, that is the stimulating effect the sale of good goods at a reasonable profit has upon a manufacturer to better his products, which incentive does not exist if he is selling goods at no profit, or if he is compelled to sell poor goods that do not in themselves give the proper satisfaction that would lead to increased sales. Frequently the policy of the tradesman is to buy inferior goods at the lowest price possible and sell them at the greatest profit. This practice is very demoralizing, not only to the manufacturer but to the ultimate consumer. It is particularly gratifying, therefore, to state that there is no trade to which our Company sells that is more consistent in its demands for the better grade goods than gas companies. As a result no other trade is more greatly valued by our Company, nor no trade whose requirements are more carefully considered. To illustrate this, I would state that our Company has, at considerable expense, recently secured the services of Mr. Norman Macbeth, a gentleman who has a wide reputation as an illuminating engineer, and who is considered possibly among the foremost in that line. The services of him and his assistants in his department are to be placed by our Company entirely at the disposal of the gas fraternity, without any reference to trade relations with our Company. His work will consist in placing at the disposal of any gas company or new business manager, if you will, his services in promptly working out any problems the gas company might have regarding the efficient illumination of any public building, stores, factories, etc. I do not mean to imply that this work might not be done very effectively by the majority of the gentlemen connected with the gas company that handles these details, but expert advice from a competent illuminating engineer, whose field is necessarily broader than that enjoyed by the local man, should be of some service. We, at Chicago, are prepared to receive, from any gas company in our territory, rough plans of any interior, upon which advice is desired whereby the most efficient lighting can be secured. Such plans will be forwarded to Mr. Macbeth, and the correspondence thereafter can pass through the Welsbach Chicago office or direct with Mr. Macbeth. I think it reasonable to assume that the creating of this department by our Company, and the placing of its services at the disposal of the gas companies, would not be possible if the gas companies, instead of handling high grade goods confined their purchases to inferior goods, the sole recommendation of which consisted in low cost, or possible immediate profits, that might be derived from their sale, without reference to the character of service these goods would give the consumer.

Mr. Unmach—I think Mr. Heinrich's paper covers the field pretty well. Of course, most of it is devoted to underground work, which does not interest our Company as much as the work that is in view all the time, which gives the gas companies more trouble, and is probably not quite as expensive as the underground work. The underground work, in my estimation, should be of the best quality; but it is not tampered with as much as work that is always in view, particularly in places where the gas company has no control over the fixtures that are installed, possibly by plumbers, gasfitters or others, who do that kind of work. When a burner is out of commission they begin to tamper with the fitting that practicaly constitutes a gas fixture; it does not matter whether the fitting be in the body or in the arm. Then, after a bit, they call in the gas man to tell him his fixtures leak. Well, the trouble is they put a Stilson or a monkey wrench on the barrel fitting, throw it out of center, and so cause a leak, whereupon the poor manufacturer generally gets the "call down" from the gas company for turning out a "bad" article. My experience as a salesman in waiting on gas company buyers has been "quantity" instead of "quality." They generally come into the store, or when we call on them to quote a price, and we say, "Well, this fixture costs $2.50 for two lights." They promptly say, "Well, for how many?" Now, you take it in these smaller towns where electric companies are in the field. Where a fixture cannot be converted from electricity into gas, whereas a gas fixture or a dining room dome can be converted to electricity, the electrical men will buy a more expensive installation. They will invariably pay as much for one fixture as the gas company will pay for a dozen, and look upon the decorative features of a fixture just as much as its practical features. I think if the gas companies, as a whole, would start an educational proposition to teach the consumer to the height where he will decorate his home with good fixtures and get good practical lighting effects, a great deal of this competition with the electric lighting companies would be overcome. An electric light solicitor will tell the lady of the house she cannot decorate her dining room except by using electric light, because the gas has to be up pretty high and they cannot use those art dome effects. If they use an inverted burner the fitting will dry up and they cannot use it, and there is also danger connected with it. There are a great many in the fixture manufacturing business—we have some very good competitors in our line, and if we are only encouraged by the gas companies, we will do much better. Let them pay us a fair price for our products, give us something to figure on for them, let us cooperate with them, and then the results will turn out far better than they imagine. Instead of continually asking if we can build a fixture for 56 or 57 cents for a 2-light fixture, let them give us a chance to build them something for $1.56, and later on for $3.56. The gas company is nothing out. The necessity is to educate the consumer to pay a little more for his goods, and nine tenths of the gas companies are selling their product at cost, so if they will only increase the cost and give the consumer plenty of time to pay for it, it will be much better for everyone. The fact must be recognized that when the gas

goes through that particular fixture the income of the gas company begins immediately.

The President—We will bring this interesting discussion to a close. The last speaker in particular contributed a very valuable thought, which was propounded by his predecessor also; namely, the importance of gas companies paying attention to really decorative effects in the better class house. If you want to get and retain the lighting business, good fixtures must go in; the fixtures must be handsome, ornamental and suitable to the room, so that when it is lighted up people will say: "What beautiful fixtures; what beautiful light you have!" People are ready to pay for that sort of thing. We want the handsome homes; but people do uot care for common brackets and lamp chimney effects. There is room for a great deal of improvement in this direction. I wish to submit the resolution previously made and seconded, that the thanks of this meeting be extended to Mr. Heinrichs for his valuable and instructive paper. [Carried.]

Some Announcements.

The Secretary, before adjourning, called attention to the necessity of getting the funds to run for the next year, suggested that after adjournment a good chance would be offered the members to settle up. He said the banquet would be held that night at the Athletic Club. That the cost thereof has $4 a plate, and they were going to meet at 7 o'clock for a feast of reason and flow of soul, besides other things. To-morrow it is on the card to have a trolley ride which will cost $1. Therefore, those who would share it should just call upon the Secretary-Treasurer for the necessary tickets.

On motion a recess was ordered until 2 P.M., same day and place.

First Day—Afternoon Session.

The President—Before proceeding with our regular business I would like to call the attention of the members to the fact that in the display department of the Milwaukee Gas Company are many things that might be of interest to most of us. Among others, there is, I understand, a high pressure lamp. By that I mean something which gives about 50-candle powers to the cubic foot consumed per hour, which should be very interesting to us all. I am also told that there is an excellent display of gas stoves made in the city of Milwaukee, and that Mr. Simpson, who is in charge, would be glad to show you through the factory. I also have in front of me an interesting collection of tools, which are not patented, and not particularly offered for sale for profit, by Mr. Joseph P. Eastman, Superintendent of the Manitowoc (Wis.) Gas Company, who I think designed them. He has a competent man there who has been making that class of tools for him. He thinks they are better than any other class for the purpose, and will furnish them to you at absolute cost, as I understand it. These consist of: A standpipe ring for cleaning standpipes. This ring is 6 inches across, sharp on the cutting edge; the Star standpipe cleaner; a coke rake; an instrument to patch a retort in the back end—he puts his retort cement in and shoves it up instead of having a double slide; a hand swivel for a meter prover in testing small meters, in place of using a wrench on the meter nut. Mr. Eastman has kindly brought these useful "Wrinkles" up here, and would be interested in having you look at them. I will now call on Mr. J. D. Taylor, Jr., of Wausau, Wis., to read his paper on

TAR MACADAM.

It is my desire to make it very clearly understood from the start that, while the title of this paper is "Tar Macadam," I do not for one moment pose as an authority as to this method of street pavement. I became interested in tar macadam through the means of the residual sales ledger, rather than through my knowledge of what good roads should be; and it is my intent and purpose to interest you more in the sales of tar, and to prove if possible that we are not doing justice to this by-product.

We have all taken great interest in the upbuilding of our coke market, spending considerable money each year in advertising "smokeless fuel" and installing crushers, etc., to find in the end that we are dependent largely upon a seasonable winter to unload our stock, very often, as many of you know, having to close out at a low figure at the end of the season to make room for the summer accumulation. The larger plants, of course, all operate and maintain ammonia concentrators, while the managers of the smaller ones are continually figuring as to the possibilities of their doing the same.

The operators of both the large and the small plants seem to overlook the value of their tar, and place, by annual contracts, the entire output with the few large contracting firms, for which they receive an exceedingly low price compared with the price which is charged for the same product after having gone through a slight distillation process, sufficient to make the same salable for street paving purposes.

A tar macadam road for general purposes is about as durable, efficient and economical as any other street paving known to-day. It is purely a matter of opinion of the various engineers as to the superiority of vitrified brick or creosote block. Of course, there is no question but these are the two best pavements known, yet they are only recommended for the principal business streets and heavy traffic thoroughfare of the cities. The paving of the balance of the streets must be of a less expensive paving, and nothing better than tar macadam can be recommended for this purpose. Asphalt is practically out of the question in cities of the size that most of us represent, for the reason that repairs are impossible without the maintenance of an expensive repair department.

The advent of the automobile in such large numbers has demonstrated the fact that something must substitute the common macadam road; for, as you all know, the rapid passage of the machines, with their large rubber tires, forms a suction which draws from the interstices the dust and small stones which blow away from the road, leaving the loose stone free and ready to be jarred loose by the contact with horses' shoes and steel tired vehicles. Thus the road becomes frayed and very soon rutted.

The blue stone roads, which have been the pride of many of the Eastern States, are fast undergoing disintegration; in fact, the authorities at Washington, D. C., are experimenting now with the various tar and oil products, used through sprinkling devices, on a number of their suburban roads, to see if it is possible to protect the surface from the destructive effects of the automobile.

The tar macadam is the road that will stand up under these conditions, a very evident fact when the city of Duluth will invest $10,300 in a portable mixing plant, and will consider no other street pavement. In fact, you do not have to go farther than this beautiful city of Milwaukee for a demonstration of this fact. The steepest grade on Wisconsin street, two blocks west of the Pfister Hotel, is tar macadam. I was advised by an engineer familiar with this particular piece of work that it was laid after careful consideration; that the reasons for so doing were practically protection to the teams which are constantly passing up and down this hill. There is just sufficient rough surface to give a horse good purchase, and, while the road is smooth enough for all purposes, it is yet rough enough so that sleet and ice will not glaze it over, as in the case of asphalt to the east and west of same.

Farwell avenue is another good example of a tar macadam street. The heaviest teaming in the city goes north over this thoroughfare, yet, being down a number of years. it is in almost perfect condition. The point which I wish to emphasize is: In the face of this possible market for our product, should we be content to sell our tar from 2 to 2½ cents per gallon and see the same product return to our cities to be sold at 8 cents per gallon?

The manufacturer to whom we sell this tar simply draws it off into a still, heats it to a temperature approximately 445° F., at which point a sufficient amount of the lighter oils has been drawn off, for which the manufacturer receives from 7 to 15 cents per gallon, according to whether it is disposed of in barrels or tank lots.

The tar is drawn off, barreled and given a fancy name, with an attractive label, then sold for street paving purposes at prices ranging from 6 to 8 cents per gallon. Now, would it not be possible for small cities to divide themselves into groups, selecting a central location at which point a tar plant could be erected, a still of not less than 4,000 barrels per annum capacity, the expenses to be borne jointly by the group of plants interested and the price to be paid to each company for its tar to be governed by the sales of the finished products? The tar plant itself need do nothing more than pay its own operating expenses and interest and depreciation charges, the profits belonging to the companies that produced the by-product.

Being interested to this extent, we would be far more energetic in securing the construction of tar macadam roads in our cities and county highways. I find that authorities vary considerably as to the proper construction of such roads, but I can speak from personal observance that the following, while it may not be the best, will ever be a satisfactory road. Excavation in ordinary clay soil should be about 6 or 8 inches, on this broken stone or concrete base if desired, rolled with 10 to 15-ton roller. The next strata is composed of crushed rock not less than ¾ to 1½-inch (ring test), the same having been thoroughly heated to remove every particle of moisture. The prepa-

ration of the rock is as follows: First, it is spread out on a mixing board 12 by 15 feet square; crude tar, which has been heated to about 180°, is then poured over the rock. The batch is then turned over until every particle of the stone is coated with tar. This can be done in mixing machines, the same as used for concrete. This is placed on the road and rolled, and it becomes firmly cemented, the tar practically filling the interstices. The third strata or finishing surface is composed of granite or limestone screenings, mixed with a sufficient amount of prepared tar to cause the particles to adhere closely to one another. This in turn is thoroughly rolled and allowed to stand for 48 hours, after which teaming may be allowed to go over the road. You will note that, in such a road as this, horses' shoes and steel tired vehicles will leave a slight impression; but the next vehicle passing over the road will press this out. The road is absolutely dustproof, waterproof, and cannot be torn loose or frayed by the swift passage of automobiles; and when you figure that such a road can be constructed at an average cost of $1.20 per square yard, we should all take sufficient interest in our cities to bring this before the county or city road commissioners. The manufacturers who make a specialty of preparing this tar for macadam building will tell you that raw tar will not stand up, and should never be used in road construction. Their point is naturally well taken, but from the data I have at hand, and from engineers with whom I have talked, I gather that crude tar is just as serviceable in the base as the prepared tar, but under no conditions can the crude tar be used for surfacing.

In closing let me emphasize again the purpose of this paper is not to instruct or advise as to the construction of tar macadam road, but, if possible, to blaze the trail towards a tar market which will at least show as favorable results as the balance of our mercantile ledger accounts. We have all been too willing and ready to let the two or three contracting firms dictate to us a price, and I feel very certain that if we will simply hold together and wake up to the fact that we are producing an article for which these companies must pay us, we can make the tar well a source of revenue equal to its worth.

Discussion.

The President—This interesting paper is before you for discussion.

Mr. Cowdery—Do not let Mr. Maguire leave the room until we get some information on the subject from him.

The President—I was just going to say that Mr. Maguire had the floor.

Mr. Maguire—I have nothing to offer to the meeting. I came to meet a few of my friends here.

The President—The question under consideration is not a social engagement, but tar macadam.

Mr. Maguire—If you have any tar to sell I will take it up with you. I have been buying some tar and want a little more, and if any of the members are in the sale market I will be glad to confer with them at any time.

Mr. Cowdery—I have seen good tar macadams, also bad tar macadams. I think Mr. Maguire might be able to describe the difference between good and bad, and perhaps give the gentlemen some information.

Mr. Maguire—Gentlemen, I have nothing to say on the subject.

Mr. Glass—I am a very firm believer in tar macadam pavement, and three years ago or so Mr. Maguire would have been just as firm a believer in it; but since that time he has changed his base of operations and is now talking another kind of pavement, which will account for his not coming to the front. The pavement on Wisconsin street in this city, put down 4 years ago, is unquestionably the best piece of paving in the city of Milwaukee to-day; and that, too, after 4 years of very hard service. The great trouble has been that the city is prohibited by its charter from using any patented article, so on account of the alleged patent governing tar macadam they have not been permitted to use it here. This particular piece of pavement down here has never been paid for. I agree very heartily with all Mr. Taylor said about the use of tar macadam pavement; and I think there would be a good market for every gallon of tar made in this country for paving purposes alone if it were pushed in the right way. I have never been able to understand just why the people back of the tar macadam pavement have not pushed it. It is something that should be taken up by every gas company in the country and pushed. It would increase the returns from tar very materially and make the companies much more independent than at present. There is no question about the quality of the pavement if properly put down.

Mr. Cowdery—I am afraid I do not know much about tar macadam, and I quite agree with Mr. Glass. I believe there is every prespect of tar macadam, or some modification of it, resulting finally in being a very successful pavement. I do not see why it should not. A great deal of work has been done the last 6 years in this direction, and I believe the progress of it shows such work is going on towards success. Personally you must not think I am interested in the tar business in any way, for I am not, directly or indirectly. I have, however, had many pleasant conferences with the representatives of the Barrett Company, and have learned from them (of course, I take their statements with full faith) something as to the amount of money they have spent annually in this direction. Their President told me not long ago they had devoted some $280,000 to experimental work this year on tar macadam pavement, and that the Company had devoted a sum of money somewhat similar, but not as large, during previous years. For instance, last year it used $220,000, the year before $180,000, showing that they are doing a great deal of work in this direction. While I do not blame Mr. Taylor, of course, for preferring to retain his own tar and selling it at as high a figure as he can get, at the same time I believe in this matter, as in all other lines of business, we should take a broad, liberal view of this subject, and that if we sell our tar to the various concerns that are handling the product, in which there is some competition, and leave the matter of this spread and growth of the business and devoting the use of it to new purposes to these concerns, they will make the market in the end; for it is to their interest to do it, and we will finally reap the benefit. The only thing I think we have to look out for on our part is when we sell our product we do not contract for too long a term of years, so that as this thing comes up we may reap the ultimate benefit. That, I think, is the good, broad way of looking at the thing. Give the other fellow a chance to make something, and not only will he be benefited, but he will help you to make a good profit also.

Mr. Gregg—About 3 years ago, when we were handling our tar product, we investigated this subject quite thoroughly. Mr. Brown and myself went to Duluth, where we furnished all the pitch used in these pavements, and found it made a very satisfactory pavement. We took pictures of pavements that have been down from 3 to 5 years, and, as Mr. Taylor says, the city paid $1.65 for it. The contractor told me it cost him about $1.25, and the result as shown by the pictures was very good. That pavement was laid without a concrete base, and on a simple trap-rock foundation. They used a high grade pitch, from which they were careful to remove all the light oils and retain a certain proportion of the heavy ones, and cut back with some refined tar. I believe there have been some pavements laid in not quite such a scientific manner as that, in the smaller towns, as in Oshkosh, where they used nothing but crude tar, which they heated to a high degree, removing as much water, etc., as they could. Of course, this pavement is not as satisfactory as one made on a more scientific basis. In Washington are pavements of this character, that have been down 30 years, but they were a kind of haphazard product at that time. Some of them lasted, others did not, all depending upon the quality of tar used. I have the specifications of the pavement laid in Duluth, and also in Milwaukee, which varies somewhat from the specification in Mr. Taylor's paper. The last bitumen we furnished for that purpose was to Fond du Lac (Sheboygan street) which was laid at $1.65 per square yard; but as it was only mixed in a concrete mixer I do not know in what shape the pavement is to-day. In doing a job of that kind really you should have an asphalt plant reinforced, which would cost from $8,000 to $10,000. One reason why no more tar macadam is laid is due to the fact that, as soon as a job is specified, Warren Brothers threaten to tie up the work with lawsuits. They claim to have exclusive patents on bitulithic pavement, which is the same thing, and that fact has deterred a great many contractors from taking it up, as they do not like to get in trouble. This pavement in Milwaukee, on Wisconsin street, was laid as "bitulithic," but on account of its being a patented article the taxpayers refused to pay for it. The pavements on Jackson and Clybourn streets and Farwell avenue were laid as pure tar macadam, by people connected with Warren Brothers. They will not bid less than $2.25 for bitulithic, but if it comes as a showdown, for tar macadam, they will bid as low as $1.65 for identically the same pavement. Barrett is tied up with Warren Brothers, and cannot furnish tar to any firm for any paving purpose except as a filler.

Mr. Pratt—I do not believe I can add very much to what has been said. The tar situation is one that has given us all more or less trouble. One point perhaps not been referred to by Mr. Cowdery is the combining of the companies in collecting the products of different companies and creating a market. I think that has been discussed for a great many years, and think efforts have been made to

bring about such a condition of affairs. It means a great deal of promotion and educational work, and I presume, in making that sort of effort, any combination of companies, or any representative of a combination of companies, would run up against such a thing as that recently referred to. I know in years gone by that thing has been attempted, but, for some reason or other it has resulted ultimately in failure, either on account of some company in the combination having a little more offered for its tar than it was receiving from the combination, etc. There is always some excuse or reason why it has not been made a success, yet it would appear, if the right sort of combination of small companies could be effected, that in their particular localities it might be made a success. In any community, however, whether large or small, this plan means promotion and education on the part of those representing the combination of companies.

Mr. Corscot—It is rather news to me that there is a patent on tar macadam.

Mr. Gregg—Bitulithic.

Mr. Corscot—is that the botanical name for it? [Laughter.]

Mr. Gregg—Yes.

Mr. Corscot—In Oshkosh where they laid 2 or 3 miles of it, it is considered fully equal to asphalt pavement. I do not know that they have had any trouble regarding any injunction or contest as to the legality of their putting it down. In Madison we laid a block of it last year, on a very steep side-hill, and we were not hindered or impeded in any way. The pavement bids fair to prove fully equal to asphalt.

Mr. Unger—There are many different kinds of tar, and, as you all know, coal gas tar is quite different from water gas tar. It all depends on the temperature of the retort.

Mr. Maguire—One reference to Mr. Taylor's statement I would like to make is as to the matter of using raw tar for a binder. It is absolutely of no use. In mixing the ingredients you must be careful not to get in too much tar or your pavement will be too soft. You have to be very particular in getting the right proportions for the street. Climate has much to do with it also. In a warm climate you will use less tar and a little harder pitch than you would in a cold one.

Mr. Gregg—The specifications say you must use enough tar only to hold the materials together. In Milwaukee it is provided that it must not contain more than 35 per cent. of carbon. I had an analysis of our tar made some time ago, and the pitch ran 24.9 per cent. carbon, which was satisfactory.

The President—Does ordinary gas works' coal tar run as high as 35 per cent.?

Mr. Gregg—I do not think it does.

Mr. Maguire—No; it does not.

Mr. Gregg—I agree with Mr. Maguire that it would not be well to use crude tar in any part of it, for it disintegrates sooner or later. It would be better to get all the light oils out. That is always included in the specifications as necessary.

Mr. Eastman—Mixing tar with ashes around the gas works is the only experience I have had. It has not proven very successful in Manitowoc. As we never used any pitch, I do not know how that would work.

Mr. Walker—I have not had any experience in tar macadam, but it seems to me the laying of pavements of that character is about as old as anything else we can pick up. In 1886 I lived in a suburb 13 miles out of Pittsburgh, Pa. There was neither sidewalk nor path from the front yard to the back yard in that village, some which was laid with coal tar that came from the gas works, or that was carted from Pittsburgh. A local man made a business of laying these sidewalks, the same as concrete men lay sidewalks here to-day, and the sidewalk in front of my house, and the walk around to the rear thereof, were as satisfactory pieces of work as could be found anywhere. The walk was made of raw tar mixed with a certain proportion of pitch; that is all that was used. Of course, sand and broken stone were used in the mixture.

The President—How could he mix pitch and raw tar without heating them?

Mr. Walker—He heated the mixture, of course; but it seems to me there is nothing particularly new about the subject. I think there is no reason to doubt the durability of the pavement, because these walks to which I referred stood for a great many years, and similar walks were found to be very durable in other places.

Mr. Lauenberger—Raw tar is sometimes called "dynamite tar" by roofers, and when raw tar is mixed with heated pitch, the kettle foams. The tar cannot be used unless it is subjected to a long wait, or until the water settles out. Among the Racine pavements is a regular macadam pavement sprinkled with tar, which gives a good surface to the road, and holds the stone somewhat; but it is a failure as far as being a good, tight pavement is concerned.

Mr. Cowdery—Perhaps Mr. Walker does not take into account the fact that the sidewalk of the old days was used somewhat less roughly as compared with roads over which automobiles now go every few minutes. The automobile has introduced into street work something new, and something that it is harder to get a street to stand than anything we have ever had before. Which brings up the new problem of how to get a street that will stand automobile traffic. Another thing that I would call to your attention is this: I do not imagine any patent on this pavement is worth the paper on which it is written; but, of course, it takes a good man to stand up and fight it, and the fellow who has money and nerve enough to go ahead will never be interfered with in the world by any patent.

Mr. Gregg—As far as that is concerned, the Badger Asphalt Company could not land an asphalt job in Muskegon at one time, so they took it for tar macadam; and Warren Brothers (the bitulithic concern) started suit against them. The suit was continued 8 times and then dropped. It is only a bluff on their part, but they work it every time they can.

Mr. Walker—Mr. Cowdery's reference to my statement is only in a way correct. I did not really mean to intimate, however, that the walk put down the way I mentioned would be good enough for an automobile road, or anything of that kind; but the point brought up in Mr. Taylor's paper is that you are looking for the best outlet for your tar; and, as there are as many sidewalks as there are small roads, as far as the quantity of tar is concerned, it seems to me there is an outlet in that direction that will bring a better price for our tar than to use it exclusively for roadways. I do not mean to compare the two as far as durability is concerned.

The President—I have been more or less familiar with tar macadam for 50 years—raw coal tar—and I remember works where we mixed the breeze and tar and let it lie for several months until it got into a gummy condition, leaving the sun to partially distill it, removing the water and some light oils, being careful not to get too much tar in the mixture. The substance was rolled and it made a splendid sidewalk; but when you sprinkled a little broken stone on top and rolled it in, it made, in some instances, the most beautiful sidewalk I ever saw. When we used broken spar, for instance, it gave a most beautiful tesselated effect. I further remember how the same process was applied to broken stone. The tar and crushed rock were mixed by hand, put into piles, and then left for 6 months or longer. When wanted it was taken out, put on the ground and rolled, and it made a splendid road. Due to the natural distillation referred to, I suppose the light oils and water gradually evaporated. The French and Germans have taught us much in the line of road building, and they say that in tar macadam the water must be gotten out of the tar, that even the rock itself must be dry, for water is fatal to a proper mixing or adhesion. Every particle of water in the mixture is a sure "rotter" of the whole thing. It disintegrates if it does not rot, and must be gotten rid of. It is also plain that, in making an asphalt, you must have every interstice filled. The substance must be solid. You do not want any more loose tar than is necessary; there must be enough, not any more. You can, of course, build a road of tar alone, but all the interstices must be properly filled, otherwise you do not get anything like an ideal road. Again, not every man can apply these fundamental principles of road making, for he may lack the skill. Of course a skilled roadmaker will make a great deal better one than mere amateurs will, like most of us are. While you can get rough work done very easily, one must have skilled men to do skilled work. The all-important question to us in this connection is the sale of tar; that is what we are getting to. As the result of it I think, as far as making tar pavements is concerned, we better leave that, either to the men especially in the business or the engineers of the cities who will devote their minds and attention to it. In the meantime we will do all we can for the purpose of educating the proper authorities as to the value of tar as a road-making material. I will now call upon the author of the paper to close the discussion.

Mr. Taylor—Only a few words will suffice. As said in the paper, I do not pose as a road maker. It was simply written in the hope of bettering the tar market to us. Replying to Mr. Walker's remarks as to old roads. I was brought up in a part of New York city, where we had lots of gravel and tar sidewalks. In the winter time they were fine, but in the summer time we had the tar in the house. [Laughter.]

Mr. Walker—You should have had a skilled man make the roads.

Mr. Taylor—As to the name of the pavement, one engineer to whom I talked said, "Above all things do not call it tar macadam. There is some public prejudice against tar macadam. Call it bituminous, bitulithic, or anything you please except tar macadam." As to Oshkosh using the raw tar, I will say that the top dressing in Oshkosh was made by the Barrett people. Respecting the charge of $1.65, I got various data running from $1.05 to $1.40. So I placed it at $1.20 as being about a fair average. With respect to the disintegration Mr. Maguire speaks of, I think possibly he had in mind raw tar and missed the point in the paper where I said that the second stratum was laid with tar heated to 180°, poured over hot rock; so it was not raw tar; it had been heated and prepared. Respecting the Warren Brothers' patent, I might say that they tried to force a number of suits in Duluth, Minn., but in every instance they failed and have not won a single suit to date. Replying to the President, in regard to our keeping out of the tar road business, I heartily agree with him. I do not think any gas man has a right to build tar macadam roads; still he can go before a county board, when the question of road building comes up, as it has right to-day in Wausau, and recommend tar macadam to get rid of his tar. Of course, the point I brought out was, let us get more money for our tar.

On motion of Mr. Pratt a vote of thanks was extended to Mr. Taylor for his able paper.

The President—We will now take up the paper, by Mr. Jno. S. Unger, of Chicago, on

AMMONIA RECOVERY AT GAS WORKS.

There still seems to be doubt in the minds of some managers of medium sized coal gas works whether its pays to trouble with recovery of the ammonia in the gas liquor. It may be that these gentlemen believe the savings effected would not compensate for the time they would have to give to this new departure, or it may be that they have paid more attention to reports from gas works that have had trouble with ammonia recovery, owing to poorly designed apparatus or to poor management, than to the many instances of successful operation. The manufacture of coal gas, unfortunately, is yet much dependent upon the rough man with the shovel, who is willing to do jobs which the man, better trained mentally, refuses to undertake. Naturally, the manager hesitates to introduce new methods of procedure that necessitate a greater attention to details on the part of his men, when he has trouble already in making them attend properly to their duties, and when his foreman may tell him that any change is going to make trouble. Excepting the works where the design or the size of apparatus is inadequate or out of date, these troubles, however, are more imaginary than real, which is proved by the profits from ammonia recovery in gas works gasifying less than 3,000 tons of coal a year.

Ammonia recovery also improves the quality of the gas, as generally the gas will be better condensed and washed, and thereby, besides the ammonia, also about ½ of the sulphuretted hydrogen and the carbonic acid are removed. In addition, an ill-smelling and destructive waste product is rendered harmless and made to yield a profit.

Troubles attending ammonia recovery may be divided into:

1. Troubles attendant converting all ammonia in the gas into a liquor of sufficient strength for economical distillation.
2. Trouble with distilling apparatus.
3. Troubles of supervision.

Troubles in Generating and Washing.—Generally speaking, the conditions favoring a production of a fluid and merchantable tar also produce a high yield of ammonia from the coal, and when the tar is fluid there is no particular difficulty in working the hydraulic main without any addition of fresh water or special pumping to keep the main in good condition. High temperatures in the retorts, in connection with small charges, cause the well known troubles, especially if the mains are small or not provided with easily accessible cleaning openings. When the tar is removed in large lumps or in irregular quantities, other liquid must be added to replace the quantities taken out, and in small gas works without ammonia recovery, this is often done by adding large quantities of fresh water. As such practice would be inadmissible with ammonia recovery, the best method is to collect the liquor from the hydraulic main into a separate tank, pump it over again into the hydraulic mains, and, if necessary, pass it through a cooler to get the temperature down. To pump the liquor from the condensers and scrubbers into the hydraulic main will cause loss of the volatile ammonia, owing to the high temperature prevailing in the mains.

In spite of the frequent assertion that excessive seal is the cause of all the hydraulic main troubles, some gas works and coke ovens find many advantages with deep seal and corresponding vacuum because thereby the gas is washed better, helping out the other condensing and washing apparatus and producing a more fluid tar.

There is no doubt that the rotary scrubber, from the gas maker's standpoint, is the best apparatus for the removal of ammonia after the gas has been cooled in the condensers. For reasons of operation, however, they are not suited for small works, and tower scrubbers are usually employed, preferably in connection with an immersion washer of some kind. To get out all the ammonia, and in order to get sufficiently strong liquor, two scrubbers are necessary, with fresh water only entering the last scrubber, and ammoniacal liquor pumped over-and-over again into the first scrubber. Three gallons of fresh water introduced per 1,000 cubic feet of gas should be sufficient with properly designed flushing and spraying arrangement, and these, with the hygroscopic water in the coal, estimated at, say, 1.6 gallons per 1,000 cubic feet, and a yield of ammonia of 5 pounds per ton, will yield a 5-ounce liquor equal to 1¼ per cent. of ammonia. This strength, however, may not be obtainable, owing to insufficient condensing and scrubbing apparatus, and it will pay to use more fresh water and get the liquor of, say, 1 per cent. strength. This will cause more steam to be used in the ammonia distillation, say ¼ more as compared with liquor of 1¼ per cent., but owing to plenty of cheap fuel around coal gas works, it is better to use a little more steam than to allow a large portion of the ammonia to escape.

Distilling Apparatus.—Owing to the natural disinclination of managers of gas works to complicate the process of ammonia recovery, only apparatus for making crude concentrated liquor will be considered in the following:

Ammonia concentration is a simple process and can be worked almost automatically, if provisions are made to introduce the weak liquor, the milk of lime and the steam in constant and suitable quantities. Unfortunately, in order to diminish the first cost, or from lack of knowledge, these conditions are not obtained, with the result that the process becomes a source of annoyance and disappointment.

The temperature of the vapors, before they enter the apparatus for final condensation into concentrated liquor, determines the percentage of ammonia in the finished product; and, in order to keep this temperature at the desired degree, the thermostatic control has of late been attached to ammonia stills with beneficial results. However, if the weak liquor and the milk of lime yet remain, but in imperfect control, there will be corresponding irregularities in the steam supply, causing either a loss of ammonia in the waste or excessive consumption of steam.

A regular supply of weak liquor can be obtained by a constant hydraulic head, either by keeping the feed tank always full to overflowing, or by interposing between same and the ammonia still an auxiliary tank controlled by a float, and, as a further precaution, and in order to always see the rate at which the still is working, one German manufacturer installs a meter, made in the form of a tilting tank underneath the tank with the float. Instead of a meter, good practice is to use two feed tanks, one of which is emptied while the other is being filled.

A new method for supplying a regular feed of milk of lime in a concentrated form has lately been developed, in which the milk of lime is kept in a stirred condition and injected into the still by means of compressed air. The lime is first slaked in an open tank and then poured into a tank that can be closed air-tight, and provided with perforated pipes in the bottom through which the air enters. A vertical pipe, with its lower end open, conducts the milk of lime from the closed tank to a valve operated by the compressed air that has previously passed through the milk of lime. The air, acting on a rubber diaphragm, keeps the valve closed until the piston, in a dash pot or cataract filled with oil, in its descent, caused by gravity, releases a lever that acts on a little air valve which permits the air behind the diaphragm to escape, thereby opening the main valve. In opening, the piston the cataract is raised again, the lever locked in its previous position and the air again admitted against the diaphragm, with the result that the main valve closes, after having remained open for a few seconds, until after the descent of the piston in the cataract the operation is repeated. The time between openings is regulated by means of a small valve allowing the oil in the cataract to by-pass from bottom to top of the piston at varying speed. As the main valve, when opening, always discharges the same amount of milk of lime, the quantity of lime introduced into the still is regulated by changing the time intervals between openings. Thus, the same size of valve

can be used for a great many different sizes of stills. If this valve was omitted and you tried to effect regulation by the use of a small opening, it would soon clog up with lime.

As the air keeps the milk of lime constantly stirred, and as the air pressure will force the liquid through the pipe and the valve with a rush in a comparatively large quantity at a time, it is believed that no other method has been devised which will handle the milk of lime in such a concentrated form with equal reliability. It is safe to say that this device would deliver a milk of lime from 6 to 15 times stronger than is at present the case at most gas works. Besides, it will deliver the lime in suitable and perfectly controllable quantities, whereas ordinarily the lime is introduced in a haphazard and irregular way. Even with stills arranged for lime introduction the operation is often so annoying that lime is dispensed with, or only attempts made to give the still a little lime once in a while.

Lime for taking out the fixed ammonia should always be used in connection with ammonia distillation from gas liquor, as, in the first place, the so-called fixed ammonia, averaging about 15 per cent. of the total ammonia, is worth saving; and, in the second place, there will be less trouble with salting of the distillate, owing to the proportion of pure ammonia liberated by the lime; consequently the percentage of ammonia in the concentrate should be made higher before there would be danger of salting.

The usual practice, and on which the contracts between the gas companies and the ammonia refineries are made, is to ship a concentrate containing 15 per cent. of ammonia. It is claimed that a stronger distillate will cause losses in ammonia owing to evaporation, and that a 15 per cent. product is about the limit of strength the gas companies can make. This may be all right, where distance to be shipped is comparatively short, although it would seem that a product containing 15 per cent. ammonia, and about the same amount of impurities in the shape of carbonic acid and sulphur, which must be removed by the refiners, would be less valuable per pound of ammonia than a product containing up to 25 per cent. ammonia with most of the impurities eliminated; but when the distance becomes great, the freight that can be saved by making a stronger liquor is considerable. Thus, the freight of a 25 per cent. liquor is 40 per. cent. less per unit of ammonia than compared with a 15 per cent. liquor, and the freight of a 20 per cent. liquor 25 per cent. less. The coke oven concerns have long understood this, and have been shipping a stronger liquor, and abroad most new stills are contracted for with a provision that the liquor made may be 25 per cent. without salting. This is accomplished through a system of preheating the weak liquor in its descent in the distilling apparatus with the waste heat and other heat from the distillation column up to a certain temperature at which most of the carbonic acid and the sulphuretted hydrogen are liberated, whereas the warm liquor has still a property of retaining most of the ammonia. These gases passing upward are washed by the descending weak liquor, whereby the ammonia is absorbed again, the acid gases escaping into the atmosphere. The process is not difficult, and causes but slight complication of apparatus. Previously the same effect was accomplished by washing the vapors from the still in lime water, but by the above described process this expense for lime is avoided.

The capacities of the stills in gallons of weak liquor per hour vary considerably according to the construction. For instance, a 6-foot diameter still has a capacity of 2,200 gallons per hour, a 4-foot diameter still 800 gallons, another 4-foot diameter still only 300 gallons per hour, a 40-inch diameter still 780 gallons, a 36-inch diameter still 270 gallons, a 24-inch diameter still 110 gallons, etc. The capacity can be increased by deeper seals of the hoods causing stronger boiling and by a condenser at the top of the still, from which the condensate returns to the still, thereby, so-to-speak, drying the vapors, as the water condensed has but little capacity to retain any ammonia at that temperature.

Many complaints are heard that ammonia stills soon are destroyed by the action of the vapors in the upper part of the still. Owing to the high percentage of carbonic acid and other acid gases that destroy iron, the hot vapors have a special destroying effect on the pure iron, such as soft steel and wrought iron, but will also, in time, disintegrate cast iron.

If the acid gases are removed from the liquor before entering the still proper, this destruction would not take place, as the ammonia has little effect on iron, for which reason such removal ought to take place. However, stills can be made more durable if iron is avoided in the upper part as much as possible, and it is, therefore, good practice to use coils of lead in the cooler and condenser, through which the vapors pass, rather than condensing the vapors in iron vessels, cooled with lead coils containing cooling water. There is less danger of stoppages from deposit of salt in the iron vessels than in the lead coils, but with automatic temperature control there is very little danger of further stoppage, formerly the bugbear in the distillation of ammonia.

Troubles of Supervision.—An ammonia still of modern design, and provisions made for taking care, automatically, of the weak liquor supply, the milk of lime, the steam supply and the waste, as explained previously, will do away with the difficulties of supervision as far as the distillation is concerned. A separate man to take care of the still is, therefore, unnecessary, and besides giving a workman a little additional reward or premium to look after the ammonia recovery in addition to his other duties, there need be no additional outlay for labor in connection therewith. The testing of the liquor in a small works would be done by the superintendent or foreman, and after the apparatus has been used for some time, and the whole process has adjusted itself to normal conditions, there need be very few chemical tests, only purely mechanical operations, that do not require any extra skill.

Discussion.

The President—This very interesting and able paper is now open for discussion. I will call upon Mr. Mason to begin it.

Mr. Mason—I have not made any ammonia for the last 4 or 5 years, since which time the process has changed considerably. I am in the water gas business now. I suggest that you call upon Mr. H. M. Humphreys, who is operating an ammonia plant.

The President—I think that is a good suggestion. Mr. Humphreys.

Mr. Humphreys—I do not know that I can add anything to Mr. Unger's paper. We operate an ammonia still at our plant, of course, saving our ammonia and getting a profitable yield right along; but we have our troubles with it.

The President—What strength is your concentrate?

Mr. Humphreys—We average about 20 per cent.; from 20 per cent. to as high as 25 per cent.

The President—Perhaps Mr. Luenberger could tell us something on this subject?

Mr. Luenberger—The writer states in his paper that the steady flow of liquor and milk of lime was one of the prerequisites of a good operation; but then he turns round and suggests that in his apparatus milk of lime be injected at intervals. It seems to me the milk of lime being injected at intervals would cause some fluctuation in his heat. During the time the milk of lime was injected his steam ought to be turned on a little more than what it is after the lime has been shut off for some time. His suggestion about carrying the vapors away in lead coils is very good, if it were possible to do it and keep everything clear. The upper part of the still will disintegrate—even the cast iron will be eaten away in a few years; but it seems impossible to carry it away in lead coils in such a way as to keep the coils clean. The idea of keeping the lime stirred with the air seems very good, providing it does not cost too much to compress the air for the purpose. I do not know just how much air would be required per minute, nor what the pressure would have to be.

The President—Does Mr. Jones make ammonia?

Mr. Jones—We are trying a small plant at the present time. Our condensing apparatus is not satisfactory at all. We have not sufficient capacity and are not doing a great deal of it.

The President—I should like to hear from Mr. Wilke.

Mr. Wilke—I cannot add very much more, except that one of the greatest troubles, as Mr. Luenberger or the other gentleman said, is not having sufficient condensing capacity. Another trouble we have is to keep the lime slacked properly, and one of the great troubles you have with lime is that it varies in quality, some lime being much more readily soluble than other lime. And one more of the troubles might be in keeping a proper grade of milk of lime to pass into the still. As far as watching goes, I think even an automatic still would require a certain amount of watching, because it is almost impossible to keep the crude ammonia liquor at the same strength. The quality of the coal might vary, and so might the heat in the retort. We have quite a variation in the crude liquor—not only a variation in the amount of the ammonia, but the position of the ammonia is different. We have a great deal more trouble at certain times with what is called salting than at others. Mention has been made of the trouble that the Solvay people have had in getting rid of fumes. That is one of the difficulties with which they have been confronted on the south side. The residents there were complaining of the noxious vapors coming from the south side gas works. I think, however, the difficulty has now been remedied.

The President—Can you tell us about the remedy of the trouble due the presence of sulphuretted hydrogen, by its absorption?

Mr. Wilke—I don't know what they have done, but an engineer from some other plant took up the question satisfactorily. I think they could either burn the sulphuretted hydrogen in the chimney and pass it out in the atmosphere at such a height that it would not affect the people, or it might be scrubbed out with water, as sulphuretted hydrogen is fairly soluble in water. By running a sewer at some distance from the gas works they might remove a good deal of the nuisance that way. The fumes from the ammonia still might be just as noxious as those arising from the old-time lime purification method, sulphuretted hydrogen having a very nauseating odor and being poisonous as well. When we operated our still we found that, under ordinary working conditions, there was less than $\frac{1}{10}$ of 1 per cent. of ammonia in the crude liquor, as shown by tests. Of course our plant may have better control than some smaller plants.

Mr. Harmon—Mr. Wilke having mentioned the variations in the activity of the lime liquor, and as I have no technical knowledge on the question, I would like to ask him whether the fact of the lime being air slaked and not fresh, would have something to do with it. I asked that question as it may have a bearing on the quality of the lime that we are buying in Milwaukee.

Mr. Wilke—We find that air-slaked lime will work equally well with caustic lime when properly selected. When lime is air-slaked a good deal of it forming a carbonate becomes insoluble, and will be carried up as insoluble lime, which will tend to make the milk of lime heavier, bulkier and harder to handle. It will give more trouble in the stirring apparatus and the tank.

Mr. Harmon—The reason that prompted my question was that lime refuse from kilns can often be picked up at a nominal price, and if there is any serious objection to the use of it, such might be a pointer to those buying fresh lime.

Mr. Eastman—All the trouble seems to come from the milk of lime, and if it only amounts to 15 per cent. of the ammonia recovered in a small gas works plant, why not cut out the lime? I never ran an ammonia still and do not know if my idea is correct, but if that is where the trouble arises, why not get along without the lime? You would recover 85 per cent. of ammonia without using lime. I hardly think the 15 per cent. of ammonia saved would pay for the lime.

The President—I would like more discussion upon matters that would lead men who are not saving their ammonia in the small plants to show the advantages they could get out of it.

Mr. Pratt—I am not well up on the ammonia question; but I was very much interested in Mr. Unger's paper. He is a modest man and said very little about the particular apparatus to which reference was made indirectly in the paper. I have seen the apparatus to which he refers, have watched it in operation, and believe that it is capable of doing more than he really claims for it in this paper, that in every respect, as far as I have been able to judge, it is automatic in operation, and, to a great extent, I think, does away with many of the difficulties to which the gentlemen who have followed him have referred, and with a very small increased expense, so far as I am able to determine, in the cost of operation. On the subject in general I have nothing to say, but with reference to this particular apparatus to which Mr. Unger, in a roundabout way has made reference, I think it is one that would pay any man operating a coal gas works, particularly works large enough to operate an ammonia apparatus, to look into carefully.

Mr. Taylor—I would like to ask how small a plant can operate an ammonia still successfully?

Mr. Unger—I have not had actual experience with small gas works, but that question has often been asked. It is something that the gas manager could figure out for himself. Finding the cost of apparatus and lime, and what it will cost him to improve his condition so that he can make a suitable ammoniacal liquor, then figuring depreciation, interest and labor, he can determine whether the plant will prove profitable. Of course, if you can buy a still that works automatically and do not have to hire any more men, the labor item is very small. I understand the price of ammonia that can be commanded in most gas companies is about 8 cents per pound, and you get 5 pounds of ammonia per ton of coal.

The President—Eight cents at the ammonia works?

Mr. Unger—Yes; that is 40 cents per ton of coal. So it is matter of calculation really to determine how small works it will take in order to make the investment profitable. I know a gas works that carbonizes about 7 tons of coal a day, where they have an ammonia still and are well satisfied with it.

Mr. Humphreys—Does this small plant produce the ammonia continuously, or do they stock up their crude liquor until they get supply enough for several days' run, and then shut down afterwards.

Mr. Unger—The smallest concentrating apparatus that you could buy would take care of 20 tons of coal a day, and so if you only gasify 7 tons a day you only use it in the daytime part of the week.

Mr. A. G. Lloyd—The only thing that occurs to me is, in the caring for your liquor before you concentrate it, it might work your liquor up a little bit, you would get a better scrubbing and would not have to concentrate so much liquor or use so much steam. We are carbonizing about 4,500 tons a year and are not saving the fixed ammonia. We do not use lime at all. We find it pays us very well to save that 85 per cent. We have had a still in about 2½ years and it has about paid for itself.

The President—Do you make sulphites?

Mr. Lloyd—No; we make a concentrate of about 15 per cent. and sell it at a net of about 6½ cents at our works. We get about 4.8 to 5 pounds a ton, for which we get about 30 cents net, with less labor, and that labor is more than it is supposed to be; a still takes more attention than we would like to admit.

The President—Labor, fuel and depreciation must be deducted from the 30 cents?

Mr. Lloyd—Yes. The cost of the still, tanks, etc., we have made back in a little over 2 years. Then, of course, labor is to be deducted from that again. But we find it is a very paying investment, though just how profitable is hard to determine, because the man who looks after the ammonia still looks after other things, and it is difficult to apportion his time. We are probably making 20 cents per ton of coal net out of the operation of the still. Of course, we over-pump our liquor and run up the strength of the liquor, and in that way save a good deal of concentration.

The President—How much water per 1,000 do you add for your scrubbing purposes?

Mr. Lloyd—I can hardly answer that question. I think we are doing it on about 3 gallons.

The President—Per 1,000?

Mr. Lloyd—Yes.

The President—What strength liquor does that give?

Mr. Lloyd—About a 4° liquor.

The President—How many ounces?

Mr. Unger—About 8 ounces.

Mr. Lloyd—I should say a 4-ounce liquor would amount to about ½ of 1 per cent.

Mr. Unger—That would be about 1 per cent.

The President—What is the size of your plant?

Mr. Lloyd—We have carbonized about 4,500 tons annually.

The President—What was the first cost of the plant, everything included?

Mr. Lloyd—Approximately, about $2,000.

The President—Did that include your storage tank for concentrated liquor?

Mr. Lloyd—That would not include the wells, but it includes the storage tanks for concentrated liquor. They are not expensive. A storage tank for concentration would be worth about $400 or $500.

The President—What is the diameter of your still?

Mr. Lloyd—The size of the ammonia still is 27 inches.

Mr. Comstock—From a test made at one time regarding the lime question we found that, on the 5 benches of 6's, the labor and cost of the lime just about offset the profit; that decided the question and we cut out the lime.

The President—How much lime per pound of ammonia do you use, anyhow?

Mr. Comstock—I do not recall the figures. It is about 2 years since I was in the ammonia business, and I do not recall just the figures we did use on lime at that time.

The President—There is yet room for discussion, and it is really a very important business question to some of us. I know quite a few here who have coal gas works that are not saving the ammonia, and I also feel we have not got all the information we would like.

Mr. Lloyd—I would like to ask Mr. Unger about how large he thinks the gas works should be to make it pay to use lime? How large a works does it require to warrant the saving of fixed ammonia?

Mr. Unger—I said in my paper I thought every still should have a lime attachment. It pays to save the cents as well as the dollars. Of course, there is a little more investment, but that part of the still will last longer than any other part. By using lime you make a more desirable concentrate. You can concentrate higher, because the am-

monia that you liberate by the lime is pure. As an instance: In Dubuque last winter the liquor well was full, and it was very weak. To make it stronger they pumped the weak liquor over and over again into the hydraulic main. Of course, it had to go through the main and drip pots into the well, so the liquor got warm and a good deal of the volatile ammonia evaporated. The liquor contained about 30 per cent. fixed ammonia, and the concentrate was so very light that it was thought not to be strong enough. Analysis proved it to contain 25 per cent. of ammonia, whereas the ordinary heavy concentrate contained only about 19 or 17 per cent., which shows that the ammonia coming from the fixed ammonia in the weak liquor had enabled the concentrate to carry the other part of the ammonia in the form of salts. If there are no carbonates or sulphites in the distillates, or only pure ammonia, it will not congeal. Then, again, lime will help you boil out the ammonia better, and there will be less waste if you use lime than if you did not use any lime.

The President—Does the ammonia works pay for the carbonate or the ammonia in the liquor?

Mr. Unger—The ammonia works pay for the basic ammonia in the liquor, whether it is in the form of carbonate or sulphite.

Mr. Wilke—I think most ammonia works buy and sell on the actual basis of the ammonia, and it makes no difference whether it is in the form of salt or volatile ammonia more or less in solution or carried by water. Two points I want to emphasize. Mr. Unger says that milk of lime in the still will lessen the amount of steam required. It will facilitate the separation of not only fixed but volatile ammonia. The latter will come much more freely in the presence of the lime than without. Another thing on which sufficient stress is not usually laid is appliances to regulate the steam. I should recommend a thermostat. One of the greatest of still troubles is variation, not only in steam pressure, but also in the amount of steam. The variation of heat causes more of still trouble than anything else. A proper regulation of steam is very important in running an ammonia still, because the condensing surface in most stills is not sufficient to take care of a large excess of steam. The higher the concentrate of ammonia liquor the better the price. The Solvay people concentrate their ammonia highly and get a better price than could be gotten otherwise. There is a better demand for the higher than for the lower concentrates.

A Member—Do they get a higher price per unit?

Mr. Wilke—Twenty-five per cent. liquor, or better, concentrate is sold to powder works, which brings better prices than ordinary ammonia of less than 25 per cent. concentrate. Getting a pure product, the ammonia people are more apt to buy it, and there is more demand for it.

Mr. J. T. Mason—Referring to automatic stills, the price will bother some of the small works, and there is no reason why they should not make a small still of their own. I operated a plant at Columbus 10 years ago, and made our own still. We took two old tanks, put steam coils in them and charged them every morning, putting in about 2 bushels air-slaked lime, and started them off. Our coils and condensers were all home-made. I do not think we bought anything, so I do not see why a small plant should not put up its ammonia still. It does not take any more to watch that kind of a still than it does an automatic. When I was night superintendent I watched that still always, and did not have an extra man on it. The only man that watched it was the one that charged it in the morning and looked after it during the day. I never saw an automatic still yet that did not have to be watched. They all have to be watched. They will get plugged up—the best of them. We carbonized from 90 to 110 tons a day, and got a yield of 4½ to 5 pounds out of our little home-made still. Of course, we had our troubles, as one always will in any ammonia still. We bought air-slaked lime. Those stills were about 5 feet in diameter and about 6 feet long, built of brickwork; we charged them in the morning, and we had about a 4-ounce liquor and concentrated that up to about 15 per cent.

The President—What was the character of your condensing apparatus?

Mr. Mason—We built a box and ran our pipes through it, the water running in at one end and out at the other; we had one coil with water running over it. I do not think it is necessary for the small plant to buy an ammonia still. They usually have mechanics. All that is needed is a pipe fitter.

The President—Did you use lead pipe?

Mr. Mason—No; we used ordinary iron pipe for our condensers. That iron pipe, of course, wore out in time.

The President—How long did it last?

Mr. Mason—I operated that plant as night superintendent for 2 years, and do not think the pipes were renewed more than once in that time.

The President—What was the capacity of the plant, did you say?

Mr. Mason—We carbonized from 90 to 110 tons of coal a day.

Mr. Unger—Mr. Luenberger speaks of my having done something which I said should not be done. I put in the milk of lime intermittently. Now, to handle this milk of lime in concentrated form, I find that is the only way to do it. If you try to do it continuously the stream will be so small (not as large in diameter as a lead pencil) that the pipe will very soon stop up with the lime. By using a valve opening up every few minutes, or whatever time is necessary according to the size of the gas works, I let in about a gallon at a time, and this amount will not change the conditions in the still during those few minutes. Anyway in practice the fact of its being intermittent has not proven a disadvantage. Lead coils containing the vapors are used in several makes of concentrators, and, of course there have been troubles with stoppages, but where there is automatic temperature control there is no more such trouble. The temperature is kept at the desired degree, and that determines the degree of concentration, and you do not need to get any stoppages from salting in the coils. As to the cost of compressed air. The air required is very small. In Dubuque, where they gasify 40 tons of coal a day, they have a compressor, 4-inch diameter steam cylinder, 3½-inch diameter air cylinder and 6-inch stroke, making less than 40 strokes to a minute, and that takes care of the handling of the lime, and the temperature control, which is also run by compressed air. In some works are used big steam pumps to pump in the milk of lime and use a compressor for stirring. This device I speak of would do away with the steam pump to pump the milk of lime; and a compressor alone stirs the milk of lime and forces it into the still. In regard to the slaking of the lime: I would say it pays to use good lime around ammonia stills. It is much better slaked than the air-slaked lime which remains in lumps. If you have good lime and just give it a small quantity of water, it gets warm and disintegrates; and if you have the tank that I spoke of you can take your time about the slaking. It seems also that carbonate of lime is not wanted in the ammonia still. You want the basic lime. Someone asked about the strength of the milk of lime. Now, with the device which I mentioned you can handle a lime mixture in concentrated form. I have used successfully a mixture with 13 per cent. of lime, but it may be made much stronger if desired. As to watching an automatic still: I do not think there are very many automatic stills in use. Mr. Mason said the automatic stills he had seen needed watching. I would like to know about that automatic still he referred to. An automatic still would have automatic temperature control and automatic introduction of the milk of lime. There are but few such automatic stills. In gas works of fair size, the quality of the weak liquor is pretty constant. You have big wells, and in the course of the day there is very little change in the quality of the liquor. The question of the fumes arising from the apparatus has been taken up and considered. As to 15 per cent. fixed ammonia not being worth saving. It takes about 2 pounds of lime per ton of coal or 2½ pounds per pound of fixed ammonia; 2½ pounds at $8 a ton for lime will give a cost less than a cent, and you get 6 to 8 cents for your ammonia. So that there is something made in using lime. That answers the remark of the gentleman about the 5-bench gas works that did not use any lime. As to using a home-made concentrator for small works, it may be desirable, but, of course, it requires a great deal more attention than a continuous still, and a tank about 5 feet in diameter and 6 feet long could only be used in connection with a small works.

Mr. Mason—Mr. Unger says in his paper: "An ammonia still of modern design, and provisions made for taking care, automatically, of the weak liquor supply, the milk of lime, the steam supply and the waste, as explained previously, will do away with the difficulties of supervision as far as the distillation is concerned." Now he said in his remarks that there is no automatic still, while he says in his paper there is. If you take care of all these things automatically I say you have an automatic still.

Mr. Unger—I think the gentleman misunderstood me. I asked Mr. Mason if he had seen an automatic still. Mr. Mason said that all the stills that he had seen always gave some trouble.

Mr. Mason—Our own plant is the only one that I have seen personally. Almost all these things have to be watched just the same.

Mr. Kimball—I would like to ask how much the cost of maintenance, in the way of replacing his home-made still was on the home-made apparatus, and whether it would pay to make your own shell or buy a new one.

Mr. Mason—I could not give any figures, it is so long ago, and I kept none of them, but as near as I can remember it our repair expense was not great.

The President—Was the still cast iron?

Mr. Mason—No. The tank was built in the wall and was never renewed. The stills were working when I left the plant. The coils in the condenser were the only things we ever renewed. The heating coils did not trouble us, but the condensing coils did. Unquestionably they would have been better had they been made of lead; but we did not have the lead and as we had the iron pipe we used it. It would pay any plant to do it. The repairs do not offset the credit received from the ammonia.

On motion of Mr. Luenberger a vote of thanks was tendered to Mr. Unger for his able and very interesting paper.

(To be Continued.)

The Determination of Total Sulphur in Gas.

[Prepared by Mr. L. B. Moorehouse, for the Southwestern Gas and Electrical Association.]

This paper will outline and compare two methods for the determination of sulphur in illuminating gas, giving the essential features, chemical equations and calculations involved in each. For the detailed description of apparatus and method of manipulation of tests, the reader will be referred to text books on the subject. The best known method for the determination of total sulphur in gas is that given in the "London Referees Test for Purity." For a detailed description of the test, see "Gas Analyst's Manual," by Abady, or "The Chemistry of Gas Manufacture," by H. M. Royle.

Briefly, this test consists in burning 10 cubic feet of gas at the rate of ½ cubic foot per hour in an atmosphere impregnated with fumes of ammonia and collecting the condensible products of combustion. These drippings, containing ammonium sulphate and ammonium carbonate, formed from the union of NH_4 with CO_3 and SO_4, are then treated with a dilute solution of hydrochloric acid and boiled, after which a solution of barium chloride is added and the boiling continued. The barium chloride converts the ammonium sulphate into the insoluble barium sulphate, leaving the soluble ammonium chloride. The washings are first acidulated with hydrochloric acid and boiled, so that the ammonium carbonate may be changed to the soluble chloride of ammonia, thus avoiding throwing down the insoluble barium carbonate with the barium sulphate.

By filtering out the precipitate and washing same with hot water, until all of the soluble salt is dissolved away, we are left only the barium sulphate. The filter holding same is now dried, burnt and weighed. The weight in grams of

$$BaSO_4 \times 15.43 \times \frac{32}{233} \times \frac{100}{\text{ft. gas used}} = \frac{\text{grains sulphur}}{100 \text{ ft. gas.}}$$

The reason for above calculation is as follows: One gram contains 15.43 grains; the atomic weight of sulphur being 32, and the molecular weight of $BaSO_4$ 233, each gram of $BaSO_4$ contains $\frac{32}{233}$ parts of sulphur. The gas is, of course, corrected for temperature and pressure.

If it is desired to test unpurified gas, obtaining the hydrogen disulphide separate from the organic sulphur, the gas may be run through a referees' test, as above described, and the total sulphur obtained. A separate sample of the same gas may be subjected to a test for H_2S, and the difference will of course be the CS_2 and other organic sulphur. The Tutweiler test will serve as a rapid method of obtaining H_2S. It consists in measuring 100 cubic centimeters of gas into a burette containing a starch solution, and letting into the same burette a measured quantity of iodine solution of known strength. The reaction is as follows: $H_2S + I_2 = 2HI + S$. The completion of the reaction is indicated by the characteristic blue color.

Suppose a solution of iodine containing .001707 grams to each cubic centimeter is used, and 100 cubic centimeters of gas taken.

One cubic centimeter of gas equals approximately $\frac{1}{283}$ cubic feet

Atomic weight H equals 1
" " S " 32
" " I " 126

Then, each cubic centimeter of iodine used represents

$$.001707 \times 15.43 \times 283 \times 100 \times \frac{34}{252} \frac{\text{grains } H_2S}{100 \text{ feet}} \text{ or 100 grains.}$$

For a detailed description of Mr. Tutweiler's apparatus, see pages 252-255, Vol. I., Proceedings American Gas Institute.

The second method for the total determination of sulphur is one originated, and first employed by Mr. W. B. Calkins, at the Laclede Gas Company, St. Louis, Mo. A description of the apparatus may be found in "Handbook of American Gas Engineering Practice," by Latta. It consists in passing the gas over incandescent, platinized asbestos or pumice stone, then through an ammoniacal solution of cadmium or zinc chloride.

The platinized pumice serves to cause the organic sulphur to break up and unite with the H of the gas, thus changing it into H_2S, after which, according to the formula, $CdCl_2 + H_2S + 2NH_4OH = CdS + 2H_2O + 2NH_4Cl$, the sulphur is collected as CdS.

The CdS is then received into a large beaker, containing a quantity of cold distilled water, and treated with strong C.P. hydrochloric acid. The acid changing the CdS to H_2S, we are able now to titrate with iodine. A starch solution is used as an indicator.

$$H_2S + I_2 = 2HI + S.$$

Suppose we have passed .08 cubic foot of gas (corrected) and have used 7 cubic centimeters of an iodine solution of a strength of 1 gram iodine to 50 cubic centimeters of water.

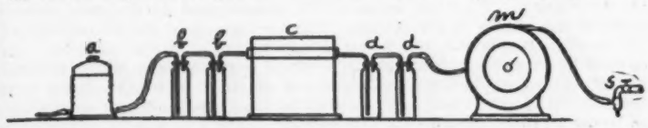
Since atomic weight of I equals 126
" " " S " 32

and as 1 cubic centimeter iodine solution represents

$$\frac{1}{50} \times 15.43 \times \frac{32}{2 \times 126} \text{ grains sulphur, or .0393 grains.}$$

Therefore, $$\frac{\text{grains sulphur}}{100 \text{ feet gas}} = \frac{.0393 \times 100 \times 7}{.08} = 344.$$

In making up the iodine solution it is best to standardize it against some positive standard as barium thio sulphate. $BaS_2O_3H_2O$. If it is desired to obtain the H_2S separately from the other sulphur, the apparatus may be set up as indicated in the accompanying figure.



A represents gas governor; *bb* are absorption cylinders containing cadmium chloride for the absorption of H_2S; *C* is the combustion furnace: *dd* absorption cylinders containing more CdCl solution for taking out the remaining sulphur compounds; *m* is the meter and *S* the water suction pump for drawing the gas through the train of apparatus.

This Calkins apparatus has been tested and found to give results which check out closely with the referees' method. To set up the apparatus and make test require less than ¼ of an hour, while the referees' test must run for hours—if according to instructions, for 15 hours. This rapidity of operation enables the gas man to determine on short notice the condition of his gas. If it is desired to obtain the sulphur in gas as it averages for a lengthy period as is given by a referees' test, this may be accomplished by storing the gas in a gasometer.

To laboratories already equipped with a test meter and governor the cost of a Calkins outfit would be about $25, while the referees' apparatus, including balance, would be about twice this amount.

Producer Gas Plants for Small Central Stations.

[Prepared by Mr. W. B. Head, for the Southwestern Electrical and Gas Association.]

In taking up this subject it is not my intention to attempt anything technical. I am not an engineer, hence I shall endeavor to discuss briefly the question from the operator's standpoint, hoping that the paper may be of some value to those small central stations which feel that an improvement in operating conditions is imperative.

It is a well-known fact that few central stations in the small towns are paying interest on the money invested in them. Many things have taken place in the past few years to make it hard for the small plant to exist. Fuel of all kinds has almost, if not quite, doubled in price. The improved gasoline lighting systems now on the market have become serious competitors. Then, too, there has been so much agitation by the public generally concerning rates that any attempt to raise them in proportion to the increased cost of operating has in most instances resulted in great loss of business. After rates have once been established it is almost impossible to raise them; this being true, a reduction in operating expenses becomes necessary. Inasmuch as fuel is the chief item in the cost of operation, any installation that will give satisfactory service and materially reduce the fuel consumption means much to the man who has the money invested. The producer plant will do this, and it is my opinion it is the only hope for many small central stations.

The small steam plant at best is an extravagant affair. The load factor is usually very low. Nearly all small steam plants use engines which take up 40 to 50 pounds of steam per horse power hour. A common return tubular boiler, which requires from ¼ to ½ of a pound of coal to make a pound of steam is the kind generally found in the small central station. In such a plant we usually find steam pumps

for boiler feeding, and oftentimes a long-stroke steam pump attached to a deep well furnishes water, saturated with scale-forming minerals for steam purposes. The pumps require 100 to 150 pounds of steam per horse power hour, and the scale put a first-class insulation between the fire and the water. I expect it it safe to say that 75 per cent. of the small steam plants in Texas are operating under conditions which require from 10 to 15 pounds of coal per brake horse power hour. The producer plant operating on Texas lignite will show an enormous saving over such plants. Several builders of producer plants are guaranteeing a fuel consumption of 2 to 3 pounds of lignite per brake horse power hour, on a 50 per cent. load factor. When we remember that Texas lignite can be had at a cost of about ¼ that of Oklahoma coals (the kind most generally used in steam plants in Texas) we see at a glance how great is the saving.

A brief description of the suction type producer plant is as follows: The outfit consists, first, of a producer or gas generator, which is a round shell lined with firebrick, with grates and ash-pit at the bottom. The coal is put in at the top through a charging chamber so arranged as to exclude the air when charging. There are two kinds of producers in use in Texas, the up-draft and the down-draft. In the first the fire is carried at the bottom, in the second the fire is on top of the coal. As to the relative merits of the two kinds I have nothing to say, further than that the users of each kind are pleased with them. The producer is so arranged that the proper quantity of air can be admitted to the fuel bed and excluded from all other parts. The gas, as it is generated by the suction of the engine, passes, first, into a scrubber or cooler, then to a mechanical tar extractor, out of which it passes through a purifier to the engine. I shall not attempt to describe any of these parts, as they differ greatly in the various makes on the market. Likewise I pass over the engine, except to say that they are all gas engines, consequently all work on the same principle, though as varied in appearance as the many makes of gasoline engines seen on the market. The most important question, and the question uppermost in the minds of all prospective purchasers, is the reliability of the outfit. It matters not how economical the outfit may be, if it cannot be depended on to meet the exact requirements of the central station it has no place as a generator of electric current. Every central station manager knows that nothing ruins the business so quickly as frequent interruptions in the service. After a year's experience with a 100-horse power unit, I feel safe in saying that a first-class producer plant is as reliable in every respect as a steam plant. A somewhat better class of labor is needed to operate a producer plant than a steam plant. Skill on the part of the engineer is not so necessary as carefulness; this especially applies to the engine. Any piece of heavy machinery, of many parts, operating at high speed, requires the best of attention. The cost of lubrication is about ½ more than that of a steam engine.

The question of the durability of the producer plant is one that pertains almost entirely to the engine, as there is almost nothing about the rest of the plant to depreciate. I have no accurate information on the upkeep of a gas engine; however, I think, compared with a steam engine, that it is considerably more. The cost of installation is about 40 per cent. more than that of a steam plant.

There are a few points it might be well to mention that should be considered by the prospective purchaser: First, the amount of water necessary for the tar extractor and scrubber; also the amount needed for cooling the engine cylinders. There are many places in Texas where it would be almost impossible to secure sufficient water for these purposes without providing cooling systems, and thus using the water over again. Care should be exercised in locating the producer room. The floor should be high enough to give the water from the tar extractor considerable fall in order that it may get out of the building easily. In cold weather the tar becomes thick and is hard to pass through a sewer without considerable fall. Some sort of skimming device should be provided to separate the tar from the water in order that the tar may be saved. Producer plants of 100-horse power and larger should always have included with the installation a coal elevator for charging the producer.

In conclusion, the successful use of lignite in the producer plant certainly means much for Texas from an industrial standpoint. Our almost unlimited supply of this coal should cause investors in large manufacturing enterprises to come to Texas where cheap power can be obtained.

Bureau of Information, The American Gas Institute.

Under the direction of the Institute it has been decreed: 1. That the privilege of submitting questions be limited to members of the Institute. 2. Neither the Board of Directors of this Institute, nor the Institute as a body, make themselves in any way responsible for the statements of fact or expressions of view given out by the Bureau of Information.

BUREAU OF INFORMATION, THE AMERICAN GAS INSTITUTE,
HEADQUARTERS, 1943 COMMERCIAL NATIONAL BANK BUILDING.
W. A. BAEHR, Chairman. CHICAGO, ILLS., June 29, 1909.

Question No. 55.—"Please give a list of the best books, or other sources of information, on American practice in gas distribution?"

ADDITIONAL ANSWER-AT-LARGE TO QUESTION NO. 54.

Question No. 54.—"In the matter of gas lamps which are owned by gas companies and are rented to consumers, are there any cases where the rental system has not proven satisfactory, or where another system has proven more satisfactory?"

The following additional answer-at-large to this Question has been put in

By Mr. George W. Thomson, Manager, New Business Department, Suburban Gas Company, Chester, Pa.—Considering this from the Company's standpoint, and on the same basis as other propositions that is a fair profit on investment. Figuring that the Company will put out 500 lamps on the rental plan, which, if they stuck (no doubt) will mean a fair profit and ownership of the lamps in five years of the

500 by 3 by 5	$7,500
Less cost of lamps	3,000
Velvet	$4,500

The same on the sales plan would say:

500 + 8 =	$4,000
Less cost of lamps	3,000
Profit	$1,000

The figure 3 represents rent received for lamps; that is lamps that are rented and maintained at 50 cents per lamp per month, $3 of which is credited to maintenance and $3 to lamp. The figure 8 is selling price, without maintenance. Space will not allow us to go into the arguments for and against the sale vs. rental, but, from our standpoint, as well as from the customers, we have found the rental to be much the better proposition.

Items of Interest
FROM VARIOUS LOCALITIES.

"V. F.," writing from St. Louis under date of the 6th inst., says: "If straws indicate possibilities at any other save election times, they surely are pointing now to the election of Mr. W. K. Bixby as President of the Laclede Gas Light Company, of St. Louis. Mr. Bixby not long ago resigned from the Chairmanship of the American Car and Foundry Company. He is well equipped for the position, both through personality and training."

THE voters of Sarnia, Ont., have, by a majority, declared their acceptance of the plan to extend the franchise of the Sarnia Gas and Electric Light Company for a period of 20 years.

MR. F. A. SCHROEDER, who has been managing the Spencer (Mass.) Gas Company, resigned that post to become Assistant Manager of the Lloyd Osbourne mills of the United Engineering and Foundry Company, Youngstown, O.

THE Massachusetts Board of Gas and Electric Light Commissioners has granted the Spencer (Mass.) Gas Company permission to issue 660 shares of additional capital and bonds (5's, to run 20 years) in the sum of $85,000. The proceeds of sale are to go to the redemption of ceptain promissory notes outstanding, and the balance will go towards reconstruction.

MR. JOHN WHALEN, having completed the task of overseeing the construction of the new gas plant at Maquoketa, Ia., for Mr. Crawford, has accepted the position of Manager of the plant at Champaign, Ills.

ACCORDING to the report of General Manager Snow the output from the municipal gas plant at Holyoke, Mass., for the month of June, showed an increase of 7,731 cubic feet over the sendout for the corresponding month of last year. The gain in electric output there is little short of amazing, it having, for the like period of 1908, reached no less than 217,710 kw., or just inside of 59 per cent.

THE Public Service Commission for the First District has sustained an issue of $200,000 bonds (under its $5,000,000 mortgage), the proceeds to go to acquiring new property and necessary new construction, by the Kings County Lighting Company. This Company's output increase goes on at the rate of 20 per cent. per annum.

THE properties of the Stoughton (Mass.) Gas and Electric Company have been purchased by the Edison Illuminating Company.

MR. W. H. ESLINGER has been chosen to succeed Mr. Mat. H. Akers, whose business had grown to such an extent as to oblige him to decline a re election on the Louisville (Ky.) Company's Board of Directors.

GOVERNOR DRAPER has reappointed Mr. Alonzo Weed to membership on the Massachusetts Board of Gas and Electric Light Commissioners.

MR. HENRY T. WILLIAMS, acting as Solicitor for Messrs. Wm. Rodenhausen, H. H. Huplet and John Freiling, will to-day apply to the

Governor of Pennsylvania for the right to operate the Sellersville Gas Company, "the character and object of which" are to manufacture and supply gas to the citizens of Sellersville, Bucks county, Pa.

NATURAL gas was supplied to the citizens of Cincinnati for the first time the morning of the 1st inst.

JUDGE PHILLIPS has dismissed the injunction suit brought some time ago by Mrs. Margaret Smith to prevent the Peoples Gas Light Company and the Cleveland Gas Light and Coke Company from perfecting a transfer of franchises and other property to the Columbia Gas and Electric Company, of Cincinnati, O.

WITH much pleasure we note the promotion of Mr. Howard Bixby, now in charge of the works of the St. Catharine's (Ont.) Gas Company, who, on the 1st prox., takes charge of the plant at Holland, Mich., which is a member of the group of works now being operated by the Kelsey-Brewer Company, of Grand Rapids, Mich.

ADDING to our mention of gas rates last week respecting Boston and vicinity, and other parts of Massachusetts as well, we omitted to note Worcester, in which flourishing city the gas rate was put at 80 cents per 1,000, January 1, 1909.

AT the annual meeting of the New York and Queens Gas Company, held in Flushing, N. Y., at the advertised time, no change was made in the Board of Directors.

THE Laclede-Christy Clay Products Company, of St. Louis, Mo., under date of the 12th inst., informs us that it is under contract to construct benchwork for the Companies at Watertown, Wis.; Paris, Ky.; Tacoma, Wash., and Sherman, Tex.

THE City Council, Richmond, Va., has set aside the sum of $9,500 to be expended on betterments by the Trustees of the Municipal Gas Works. Of this $5,750 was specifically applied to main extensions.

THE proprietors of the Ionia (Mich.) Gas Light and Coke Company have decided to increase the capital stock to $75,000, an increase of 50 per cent.

MR. J. W. HUGHES has been put in charge of the gas division of the manufacturing plants of the Rome (N. Y.) Gas, Electric Light and Power Company. Meanwhile General Manager Field is quite busy seeing to it that the distributing division is being brought nearer-to date.

ACCORDING to the report submitted last week by United States Commissioner Shields, who has had the handling of the gas rebate fund, and who has admirably handled it as well, the Northern Union Gas Company has an unclaimed balance of its refund money belonging to former consumers, which balance amounts to $24,072.86. In reporting this the Commissioner said: "By Saturday, July 3, 1909, all money due to consumers has been repaid except $24,983.61. Of this sum $910.65 is covered by alleged assignments, as to which it has not yet been determined whether the assignor or assignee should receive it, and by affidavits of claimants which have not been drawn in proper form or the validity of which has not been determined. Except for this $910.65 every consumer whose present address has been ascertained either by the Special Master or the gas company had been paid, except such claims as were presented within the previous 24 hours, which would be paid in the course of the current week. Neither the Special Master nor the gas company has been able to ascertain the present addresses of those who cannot be found at the address where their payments of overcharge were made, and no claim has been made by them or on their behalf for any money due them. After commending the newspapers for the aid they gave to the work of repaying the gas overcharges through the publication of articles telling where and how the money was to be returned the Special Master recommends the discontinuance of the special disbursing bureau and requests instructions as to the disposition of the unclaimed balance. Judge Lacombe, to whom Commissioner Shields submitted the report, has directed that the statement be presented to the Circuit Court for disposition on July 27."

THE South Boston division of the Boston Consolidated Gas Company is now comfortably situated in the Post Office building, 412 Broadway, corner F street.

ATTORNEY-GENERAL WEST will appeal to the Federal Supreme Court for a further opinion respecting the Vandewater law which prohibits the piping of natural gas outside the State of Oklahoma, which last was recently declared invalid.

AT last the Bridgeport (Conn.) Gas Light Company has become active in respect of the proposed piping by it, to the outlying settlements of Stratford and Fairfield, of a gas supply. The Connecticut Legislature has passed a measure enabling the Company to do this work, the act specifying that the selling rates in the named places shall not exceed those ruling in Bridgeport.

THE Whitewater (Wis.) City Council early this month advanced to second reading the franchise under which the applicants propose to construct and operate a water gas plant in the place named. The maximum selling rate is proposed at $1.40 per 1,000.

AN effort is again being made to put the plant and business of the Fremont (Neb.) Gas Company on a proper and paying basis. This enterprise should be in the hands of Fremont resident capitalists, under which ownership and direction there can be little doubt that it would prove a successful concern.

GEN. MANAGER E. A. POTTER, of the Great Falls (Mont.) Gas Company, says the plant will be in active operation prior to November 1st, and that the initial distributing system will be not less than 10 miles. That's the way to do it.

MESSRS. HAAS & GOEHRING are pegging away at the authorities of Seward, Neb., for a 20-year franchise under which to construct and operate a gas works in that thriving settlement. The hitch mainly seems over the maximum selling rate, which the proprietors ask shall be put at $1.75 per 1,000. It does seem a trifle high; but the short term of life of the franchise (20 years) justifies it.

WATER VALLEY, Miss., is trying to induce capitalists to invest there in "public utilities," namely, a gas works and trolley railroad. Water Valley is now operating a municipal electric lighting plant, which, according to a correspondent, "Sometimes furnishes light; sometimes not."

THE net earnings of the Denver (Col.) Gas and Electric Light Company for the month of June last were $79,835, as against $59,473 the corresponding 30 days a twelvemonth ago.

EARLY this month a special election was held in Oklahoma City, Okla., to determine whether or not the franchise under which the Oklahoma Gas and Electric Company proposed to transact business in that city for the next 25 years, should be granted. The proposition in favor received a majority of 925 votes in a total ballot of 1,556.

THE American Trust and Savings Bank, of Chicago, will, on and after October 1st next, pay the principal of the 10-40 issue of 5 per cent. bonds made by the Joliet (Ills.) Gas Light Company in 1898.

"B. H.," writing to the JOURNAL from San Francisco, Cal., under date of the 5th inst., says: "Two young negro thieves, whose specialty seems to have been the robbing of gas meters, were arraigned before the City Recorder last Saturday following their last haul made in a restaurant and a nearby beer saloon on Peters street, and John Kilgore, the apparent leader, was given 30 days each in two cases, while Solomon Bush, the understudy, was given 30 days in a single case. The neighborhood in which the last burglary occurred has been noted for some time past as short in money by the collectors, but the shrinkages were seemingly unexplainable. A watch was placed upon one quarter that seemingly suffered the most, with the result that the two negroes above named were soon caught right in the pilfering act. It was amusing to hear them, having pleaded not guilty, attempting 'to explain away' the testimony."

IT is quite on the cards that the gas plants at Palmyra, Newark, Clyde and Lyons, N. Y., which are controlled by Mr. Wm. T. Morris and associates, will in near time be closed down to the extent that one plant will, with the aid of high pressure distribution, supply the named places.

GAS men will be interested in the tentative news that the Chapman Valve Manufacturing Company and the Pratt & Cady Company are considering the advisability of joining forces.

THE Beverly (Mass.) Gas and Electric Company has been empowered to extend its main system to and through the outlying settlement of Topsfield.

IT is stated on pretty reliable authority that as one actual result of the city's eagerness to engage in the construction and maintenance of a municipal gas works for New York in 1905, the present standing of the case is as follows: In that year $605,000 were set apart and later on expended in the purchase of three plots of land, respectively in the boroughs of Manhattan, Richmond and Queens, whereon the gas plants were to be constructed. In Manhattan, at Avenue A and 90th street, a plot was purchased which cost $350,000; it is now rented to a firm of bill posters, who pay $30 per month for the privilege of smearing the inclosing fences with posters; the plot in Queens, bought at a cost of $200,000, is rented to a junkman named Shannon, at a rental of $2 per month; the $55,000 site on Richmond Terrace, Staten Island, as rented, nets the city $40 per month. Meanwhile, the general charge stands thus: Income from rentals, total, $3,456; outgo on interest account, $118,566. It is not all loss, however; in fact there is really a profit on it, for the advance in real estate values in the concerned parcels is said to amount roughly to $120,000. The real joke in the blundering, however, is pretty well shown over the site that was selected in the Borough of Manhattan. As to size, it would be just large enough to contain and retain one holder of like size to the 15,000,000 foot holder (just across the East river) in the new Astoria plant of the Consolidated Gas Company.

The Market for Gas Securities.

The market for city gas shares was steady during the week. In fact, at one time it looked that the boom in Consolidated, which is now perhaps a fortnight overdue, was on. The rise, however, was only of the yeasty nature; but the genuine one cannot be much longer restrained. The opening price to-day (Friday) was 140 to 140¼. Brooklyn Union continues strong and dull, which is generally the condition of the gas share market. The notable exception is Washington (D. C.), which is 385 bid. Here is another security in which the fruit is becoming so ripe that, if it is soon plucked, will spoil. It won't spoil, though. We note a rather conspicuous activity in Buffalo 5's, which are in demand at 73 to 75. It looks a bit queer to see Laclede firsts and Laclede common quoted on a parity. Nevertheless, such is the case.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

JULY 19.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share:

N. Y. City Companies.	*Capital*	*Par.*	*Bid.*	*Asked.*
Consolidated Gas Co.	$73,177,000	100	140	140¼
Central Union Gas Co.—				
1st 5's, due 1972, J. & J.	3,000,000	1,000	98	101
Equitable Gas Light Co.—				
Con. 5's, due 1932, M. & S.	1,000,000	1,000	—	105
Mutual Gas Co.	3,500,000	100	155	165
New Amsterdam Gas Co.—				
1st Con. 5's, due 1948, J. & J.	11,000,000	1,000	100	101½
New York & Richmond Gas Co. (Staten Island)	1,500,000	100	37	43
1st Mtg. Gold Bds. 5 p. ct.	1,000,000	—	100	101
New York and East River—				
1st 5's, due 1944, J. & J.	3,500,000	1,000	104	107
Con. 5's, due 1945, J. & J.	1,500,000	—	97	101
Northern Union—				
1st 5's, due 1927, J. & J.	1,250,000	1,000	94	100
Standard	5,000,000	100	—	75
Preferred	5,000,000	100	70	100
1st Mtg. 5's, due 1930, M. & N.	1,500,000	1,000	100	106
The Brooklyn Union	15,000,000	1,000	139	141
1st Con. 5's, due 1948, M. & N.	15,000,000	—	91½	92
Yonkers	999,650	500	130	—
Out-of Town Companies.				
Bay State	50,000,000	50	¾	⅞
" Income Bonds	2,000,000	1,000	—	75
Binghampton Gas Works	450,000	100	—	65
" 1st Mtg. 5's	509,000	1,000	90	96
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	5	8
Bonds, 5's	5,250,000	1,000	73	73½
Capital, Sacramento	500,000	50	—	35
Bonds (6's)	150,000	1,000	—	—
Chicago Gas Co. Guaranteed Gold Bonds	7,680,000	1,000	104	106½
Cincinnati Gas and Electric Co.	29,500,000	100	92	93
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	96	98
Columbus (O.) Gas Lt. & Heating Co.	1,662,750	100	90½	91
Preferred	3,038,500	100	75½	80
Consumers, Toronto	2,000,000	50	200	204
Consolidated, Baltimore	11,000,000	100	—	105
Mortgages, 6's	3,800,000	—	—	118
Chesapeake, 1st 6's	1,000,000	—	—	—
Equitable, 1st 6's	910,000	—	—	—
Consolidated, 1st 5's	1,490,000	—	—	112
Consolidated Gas Co. of N. J.	1,000,000	100	15	17
Con. Mtg. 5's	990,000	1,000	92	95
Bonds	75,000	—	—	100
Denver Gas and Electric	458,000	—	102	105
Detroit City Gas Co	5,000,000	50	—	50
" Prior Lien 5's	4,619,000	1,000	97	100½
Detroit Gas Co., 5's	381,000	1,000	75	80
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	—	101
Essex and Hudson Gas Co.	6,500,000	—	39	40
Fort Wayne	2,000,000	—	—	—
" Bonds	2,000,000	—	55	—
Grand Rapids Gas Light Co., 1st Mtg. 5's	1,225,000	1,000	104½	105
Hartford	750,000	25	190	200
Hudson County Gas Co., of New Jersey	10,500,000	—	112	113½
" Bonds, 5's	10,500,000	—	103	103½
Indianapolis	2,000,000	—	60	70
" Bonds, 5's	2,650,000	—	104½	105
Jackson Gas Co.	250,000	50	82	—
" 1st Mtg. 5's	200,000	1,000	97	100
Kansas City Gas Light Co., of Missouri	5,000,000	100	—	96
Bonds, 1st 5's	3,822,000	1,000	102	104
Laclede Gas Co., St. Louis	10,000,000	100	104	105
Preferred	2,500,000	100	—	98
Bonds	10,000,000	1,000	104	—
Lafayette Gas Co., Ind.	1,000,000	100	—	60
Bonds	1,000,000	1,000	60	65
Louisville	2,370,000	50	143	145
Madison Gas and Electric Co.				
" 1st Mtg. 6's	860,000	1,000	106	108½
" 6 per cent. scrip, due 1910	100,000	25	60	60½
Massachusetts Gas Companies, of Boston	25,000,000	100	63	63
Preferred	25,000,000	100	90	—
Montreal Gas Co., Canada	2,000,000	100	218	218½
Nashville Gas Light Co.	1,000,000	100	110	—
Newark, N. J., Con. Gas Co.	6,000,000	—	86	88
Bonds, 6's	6,000,000	—	127	128
New Haven Gas Co.	2,000,000	25	200	—
Peoples Gas Lt. & Coke Co., Chicago	25,000,000	100	115½	116
1st Mortgage	20,100,000	1,000	—	—
2d "	2,500,000	1,000	104	—
Rochester Gas & Electric Co.	2,150,000	50	88	—
Preferred	2,150,000	50	118	—
Consolidated 5's	2,000,000	—	104½	105½
San Francisco Gas Co., Cal.	15,500,000	—	—	—
St. Joseph Gas Co.—				
1st Mtg. 5's	751,000	1,000	100	102

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DIVIDEND NOTICE.

AMERICAN LIGHT AND TRACTION CO.,
40 WALL ST., NEW YORK CITY, July 14, 1909.

The Board of Directors this day declared from the net earnings of the Company the regular quarterly dividend of one and one-half per cent. (1½ per cent.) on the preferred stock of this Company, payable August 2, 1909, to preferred stockholders of record at the close of business July 20, 1909. The Board also declared, from the undivided profits of the Company, the usual quarterly dividend of two per cent. (2 per cent.), and an extra dividend of one per cent. (1 per cent.) on the common stock of the Company, payable August 2, 1909, to common stockholders of record at the close of business July 20, 1909. The Board also declared, from the undivided profits of the Company, a dividend of one share of common stock on every ten shares of common stock outstanding, payable on or before September 30, 1909, to common stockholders of record at the close of business July 20, 1909. The transfer books for both preferred and common stock will close July 20, 1909, at 3 o'clock P.M., and will reopen August 2, 1909, at 10 o'clock A.M.

1780-1 C. N. JELLIFFE, Secretary.

Position Wanted
As Manager or Superintendent,

By a man who has had experience and is familiar with the manufacture and distribution of coal and water gas and can deliver the goods. Address, "O. K.,"
1779-2 Care this Journal.

Position Wanted
As Superintendent,

By a competent gas man who has had practical experience in all branches of the business, both coal and water gas. At present employed. A-1 references.
1755-tf Address, "R. C.," care this Journal

Position Wanted
As Bookkeeper or Cashier,

By an experienced gas office man. Best of references. At present employed. Would prefer a live company.
1779-2 Address, "BILL," care this Journal.

POSITION WANTED AS MANAGER.

Gas lighting or new business departments. Thoroughly familiar with all appliances, for both lighting and heating, their construction, installation, operation and sale, with the buying of same, etc. Have had 18 years' experience on both natural and artificial gas, also main line construction and services, house piping, etc. Would prefer locating in the South. Can get the business and show results. State salary in first letter. Address, "BUSINESS,"
1780-1 Care this Journal.

WANTED,
POSITION AS SOLICITOR.

Salary or salary and commission. Have good record as a business getter. Can furnish best of references. Employed at present but wish to make a change.
1780-1 Address, "ERIE," care this Journal.

Position Wanted.
First-Class Repairer, Tester and Prover for Prepaid and Ordinary Gas Meters.

Has thorough knowledge and experience of routine work of meter repair shop. With gas company in large or small city. A-1 references. Address, "SHOPMAN,"
1780-2 Care this Journal.

Commercial Man,

With 5 years' experience specializing on industrial and lighting business, will be open for engagement Sept. 1. Will furnish references and invite thorough investigation of record. Would consider combination gas and electric proposition.
1780-1 Address, "COMMERCIAL," care this Journal.

Position Wanted.

A married man, 31 years of age, with 9 years' experience in all branches of the gas business, wishes a position as superintendent or manager of a small or medium size water gas company. Thoroughly experienced in getting results on large or small water gas sets, also new business. At present employed by one of the largest operating companies in the United States. Best of references furnished.
1780-tf Address, "S. H. P.," care this Journal.

WANTED,

For Western territory, an aggressive and competent traveling salesman for a leading line of gas ranges and heaters. State age and experience.

Address, "MANUFACTURER,"
1767-tf Care this Journal.

WANTED,
EXPERIENCED GAS MAKER,

To operate Lowe improved water gas apparatus. Address, "LOWE,"
1780-1 Care this Journal.

WANTED,
COMPETENT DRAFTSMAN.

Must have thorough knowledge of gas bench designing. Position permanent and salary liberal for right party. State experience.
1775-tf Address, "BENCH," care this Journal.

WANTED,
A GOOD WATER GAS MAKER

Who can get results, and that is able to take care of machinery. Permanent position and good salary to right man. Send references.

Address, "WATER GAS,"
1779-3 Care this Journal.

WANTED,
Retort House Foreman for 30,000,000 Coal Gas Plant.

Applicant should preferably, but not necessarily, have had water gas experience, and must be experienced in the handling of negro retort house labor. Wages, $75 per month to one who can show results. Address, "RETORT,"
1780-tf Care this Journal.

STATION METER FOR SALE.

One Maryland 4-foot 6-inch station meter with Hinman drum, in first-class condition; $375 f.o.b. cars, Beaumont, Tex.

BEAUMONT GAS LIGHT CO.,
1779-3 Beaumont, Tex.

WANTED AT ONCE.
Second-Hand Compressor, in Good Working Order.

One capable of handling 15,000 cu. ft. of gas per hour against 100 lbs. pressure. Full description, with lowest price, to
1780-3 BESSEMER GAS CO., Bessemer, Ala.

FOR SALE.
A Good Electric Light Plant,

At Blue Mound, Macon county, Ills., is for sale, by order of U. S. Court. Will pay 10 per cent. net on $15,000 valuation. Exclusive franchise, 11 years yet to run. For further information address
1780-1 H. CLAY WILSON, Trustee, Springfield, Ills.

FOR SALE,

One set of 4 purifying boxes 12 feet 8 inches by 10 feet 9 inches by 3 feet, in good condition, with centerseal and 10-inch connections. Also one American 8-foot station meter.
1771-tf YORK GAS CO., York, Pa.

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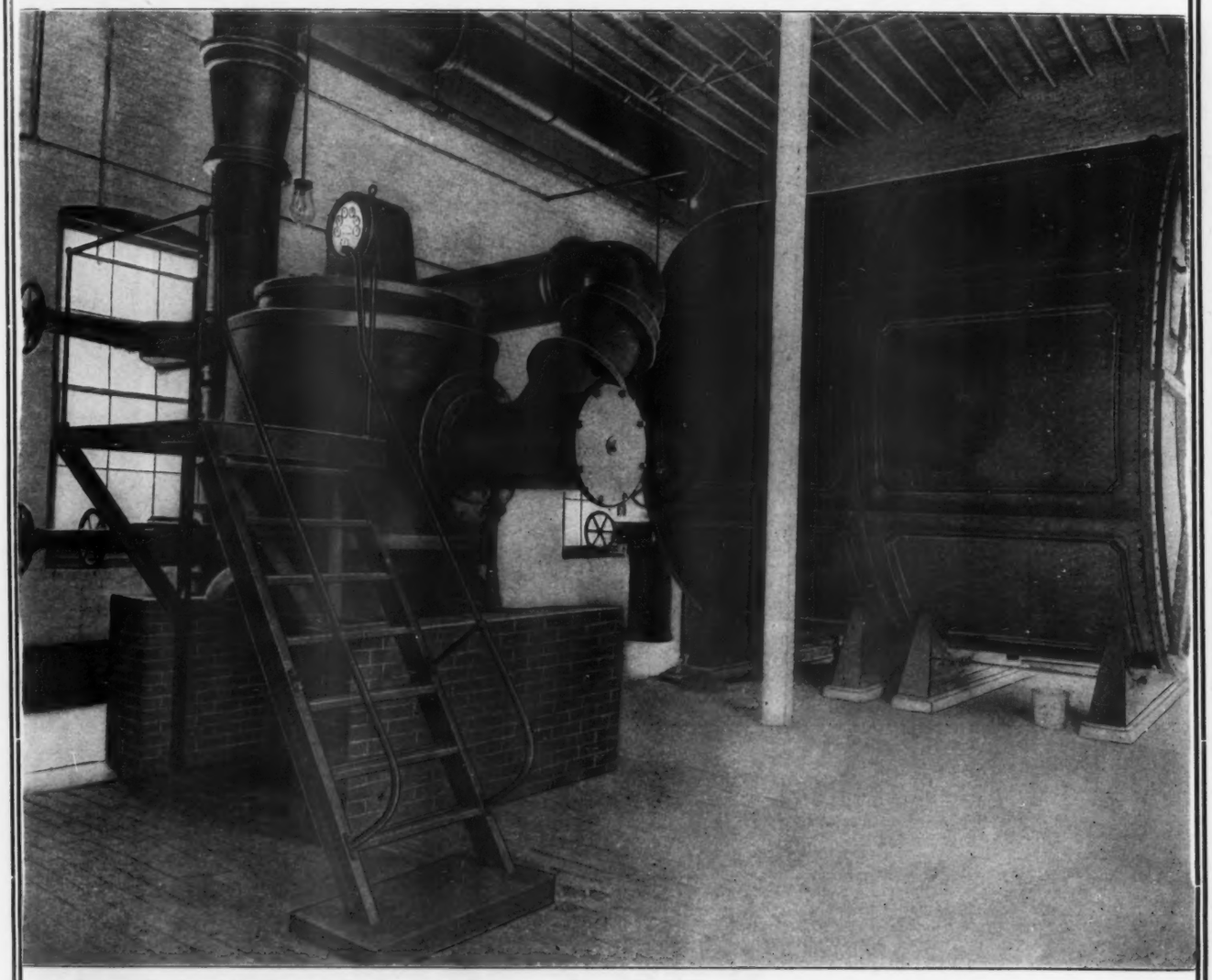

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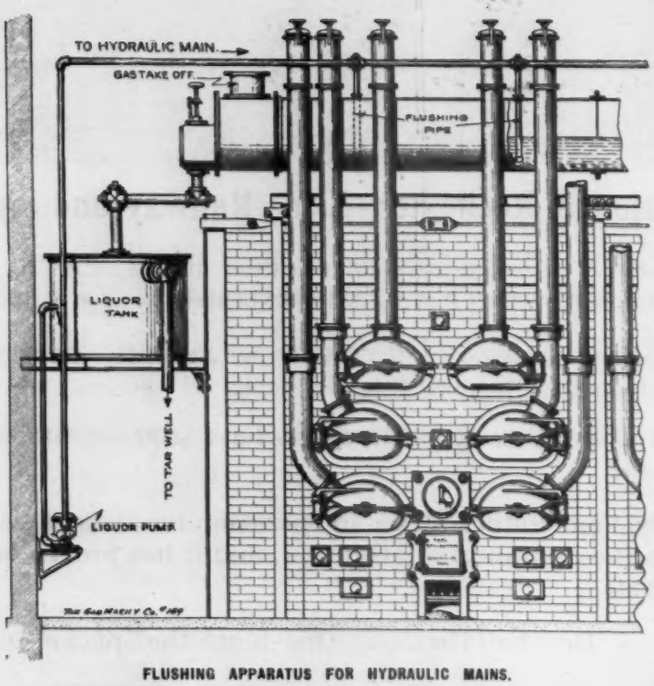

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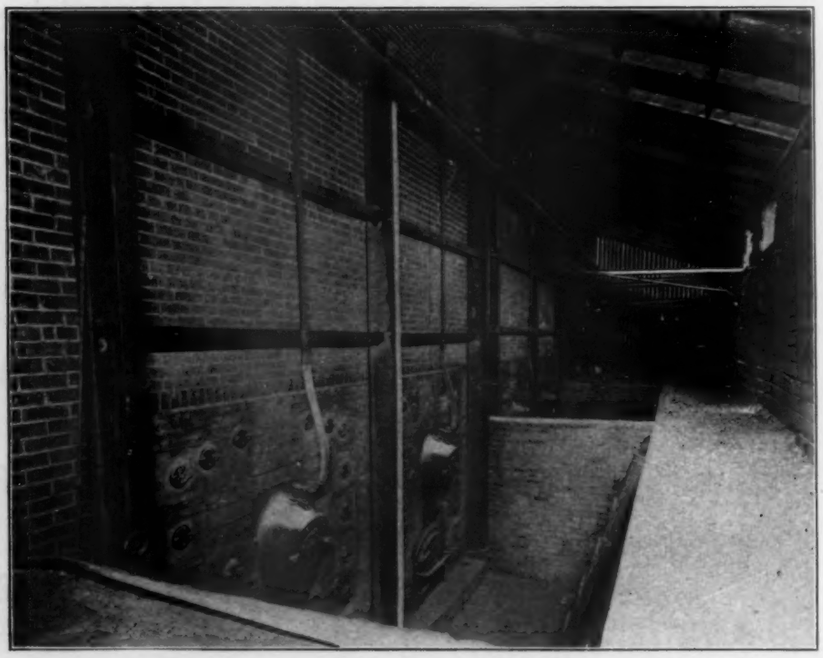

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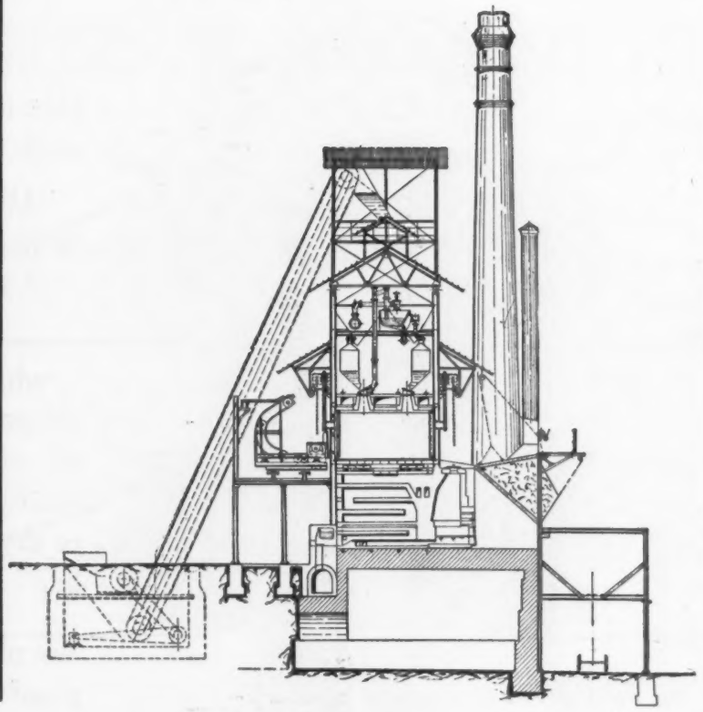

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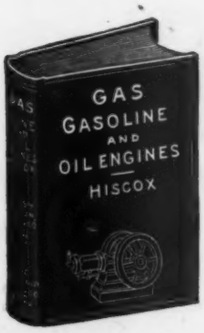

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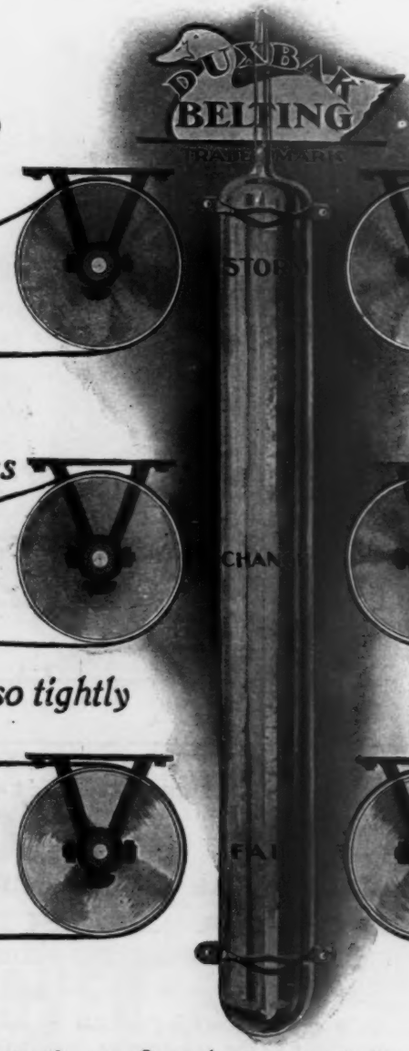

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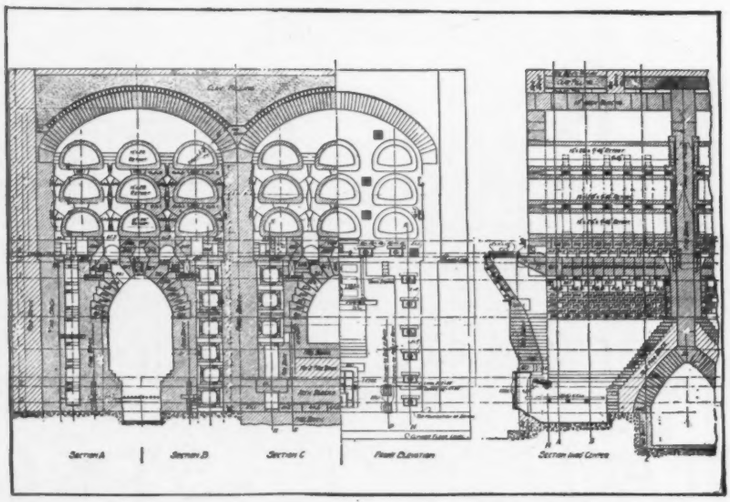

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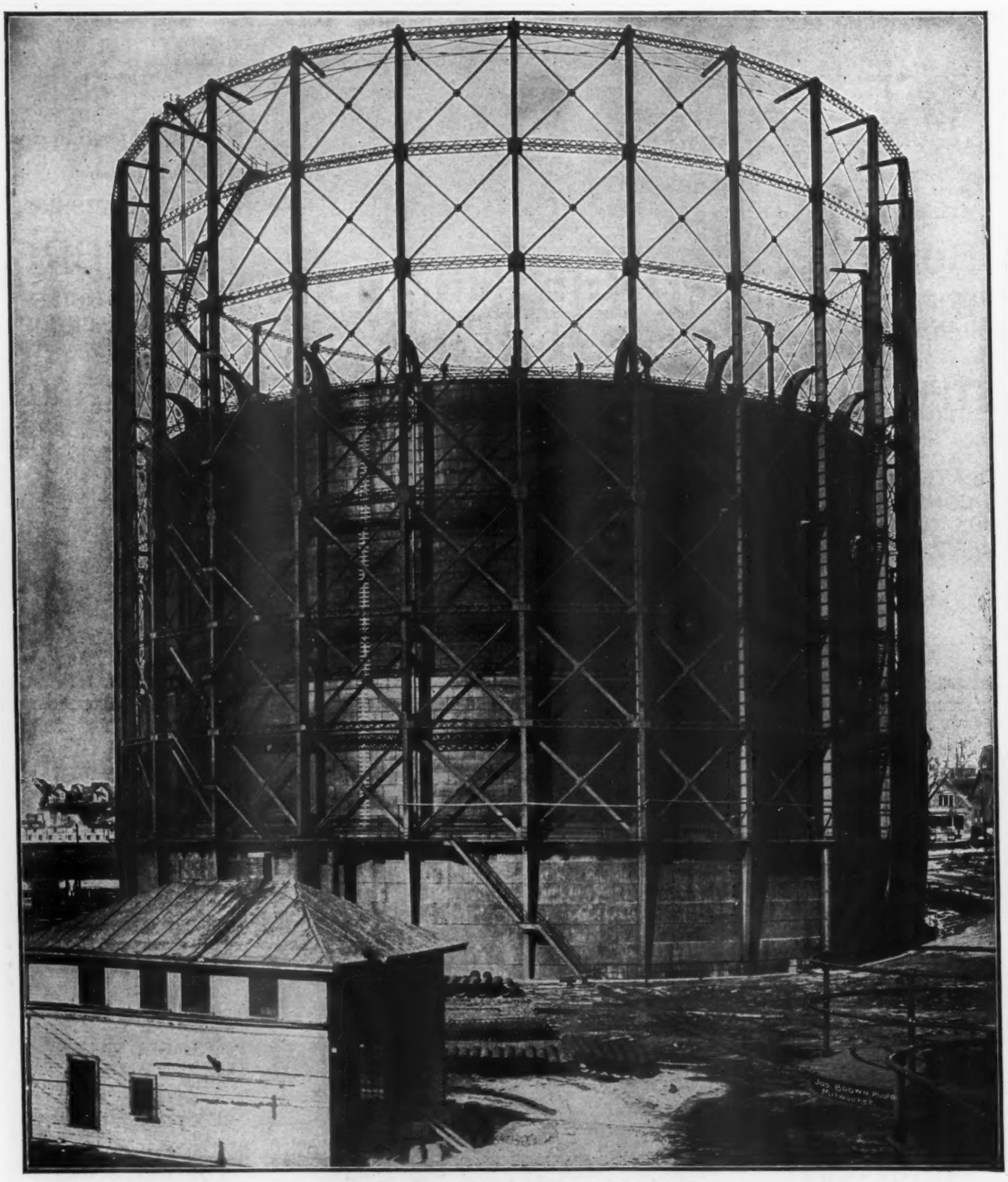

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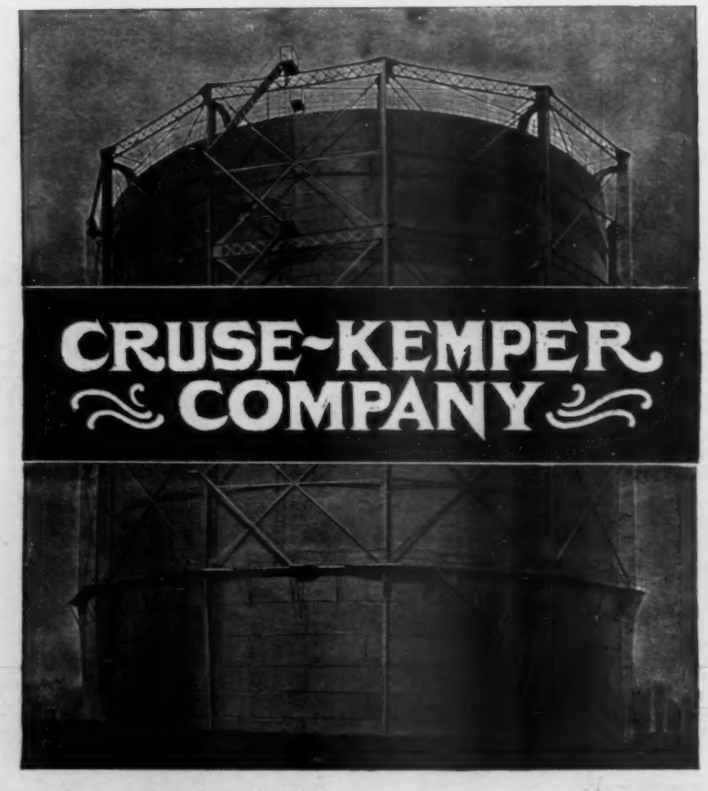

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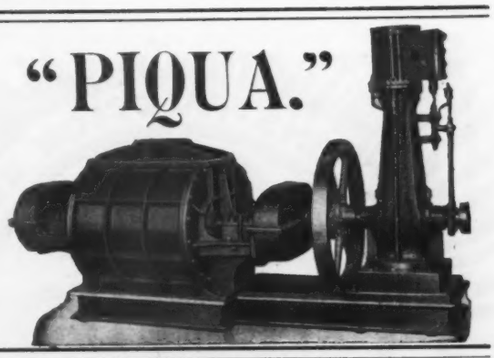

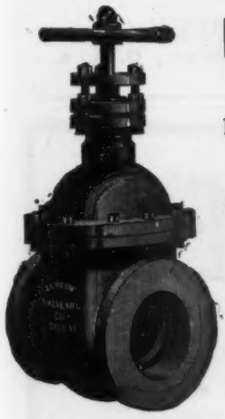

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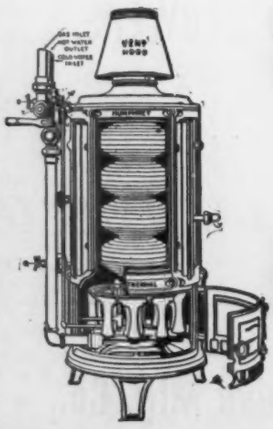

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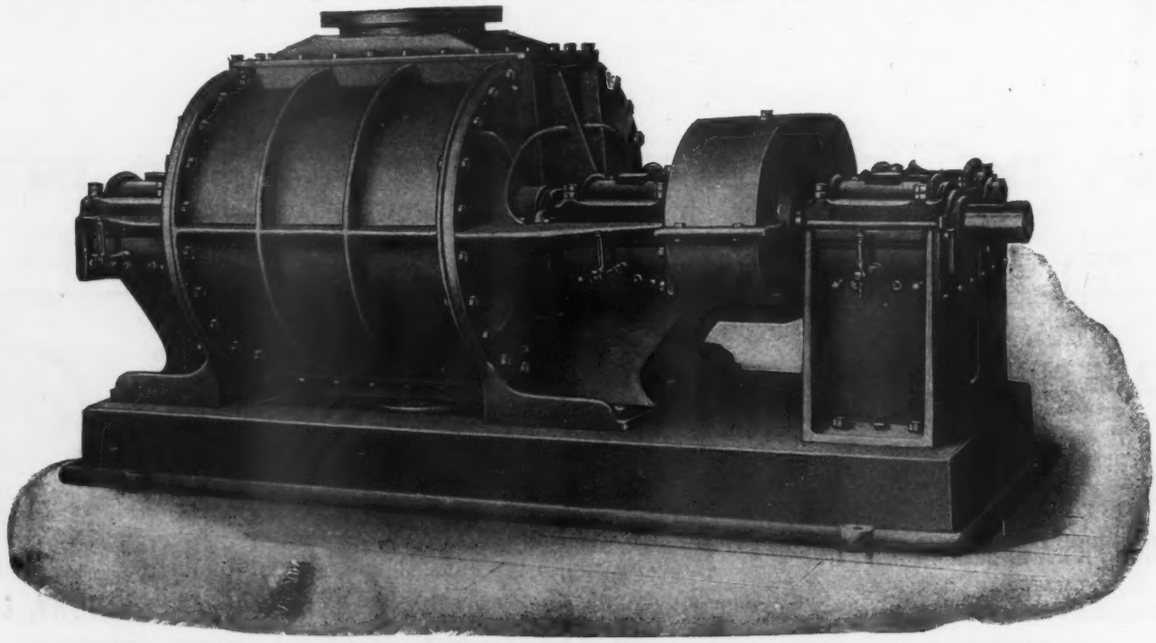

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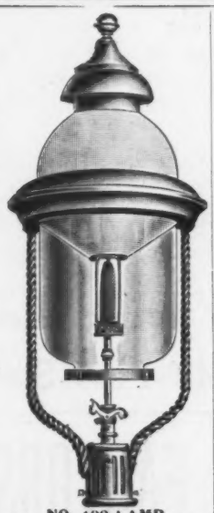

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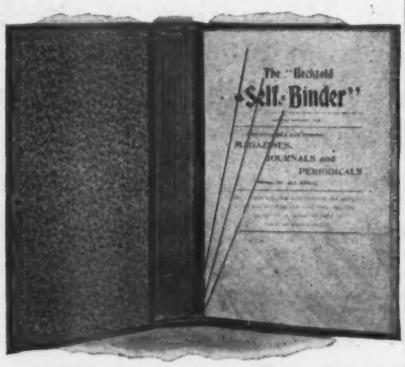

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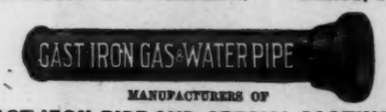

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PUBLIC LIGHTING TABLE.

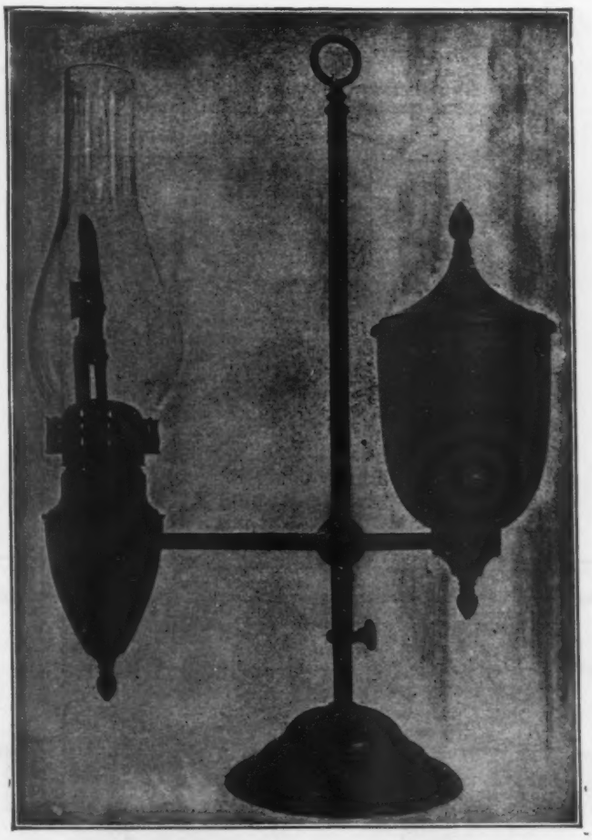
AUGUST, 1909.

Day of Week.	Date.	Table No. 1. FOLLOWING THE MOON. Light.	Extinguish.
Sun.	1	No L FM	No L
Mon.	2	No L.	No L.
Tue.	3	7 40PM	9.50PM
Wed.	4	7.40	10.20
Thu.	5	7.40	10.50
Fri.	6	7.40	11.20
Sat.	7	7.40	11.50
Sun.	8	7.30LQ	12.20AM
Mon.	9	7.30	1.00
Tue.	10	7.30	1.40
Wed.	11	7.30	2.30
Thu.	12	7.30	4.10
Fri	13	7.30	4.10
Sat.	14	7.30	4.10
Sun.	15	7.20NM	4.10
Mon.	16	7.20	4.10
Tue.	17	7 20	4.10
Wed.	18	7.20	4.10
Thu.	19	7.20	4.10
Fri.	20	8.20	4.10
Sat.	21	8.40	4.10
Sun.	22	9.10	4.20
Mon.	23	9.40FQ	4.20
Tue.	24	10.10	4.20
Wed.	25	11.00	4.20
Thu.	26	11.50	4.20
Fri.	27	12.50AM	4.20
Sat.	28	2.00	4.20
Sun.	29	No L.	No L.
Mon.	30	No L.FM	No L.
Tue.	31	No L.	No L.

TOTAL HOURS DURING 1909.

By Table No. 1.

	Hrs.Min.
January	212.20
February	183.40
March	173.00
April	151.10
May	144.10
June	138.50
July	145.40
August	160.30
September	180.00
October	201.00
November	216.30
December	233.40
Total, yr.	2140.30



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10-Candle Power.

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2d. It is remarkably steady. Will burn 24 hours continuously with less than 2 per cent. variation.

3d. It is much less dangerous than Pentane, which is a kind of gasolene.

4th. It is not easily affected by air currents in the photometer room.

5th. Since the lamp may burn continuously, the candle power of gas may be taken at any moment, if necessary. This insures steady illuminating power without waste of carburetting material.

6th. The first cost of the lamp brings it within the reach of even small gas works.

7th. Costs much less to maintain than a Pentane lamp or sperm candles doing the same service.

8th. Is not affected by the weather.

PUBLIC LIGHTING TABLE.

AUGUST, 1909.

Day of Week.	Date.	Table No. 2. NEW YORK CITY. ALL NIGHT LIGHTING. Complete Lighting in One Hour	Complete Extinguishing in 50 Minutes
		From Time Given	
		P. M.	A.M.
Sun.	1	7.02	3.27
Mon.	2	7.02	3.27
Tue.	3	7.02	3.27
Wed.	4	7.02	3 27
Thu.	5	7.02	3 27
Fri.	6	6.57	3.37
Sat.	7	6.57	3.37
Sun.	8	6.57	3.37
Mon.	9	6.57	3.37
Tue.	10	6 57	3.37
Wed.	11	6.57	3.37
Thu.	12	6.57	3.37
Fri.	13	6 47	3 47
Sat.	14	6 47	3.47
Sun.	15	6 47	3.47
Mon.	16	6.47	3.47
Tue.	17	6.47	3.47
Wed.	18	6.47	3.47
Thu.	19	6.47	3.47
Fri.	20	6.37	3.52
Sat.	21	6.37	3.52
Sun.	22	6.37	3.52
Mon.	23	6.37	3.52
Tue.	24	6.37	3 52
Wed.	25	6.37	3.52
Thu.	26	6.37	3.52
Fri.	27	6.27	3.57
Sat.	28	6.27	3.57
Sun.	29	6.27	3.57
Mon.	30	6 27	3.57
Tue.	31	6.27	3.57

TOTAL HOURS DURING 1909.

	Hrs.Min.
January	428.30
February	358.15
March	353.10
April	298.10
May	263.20
June	234.45
July	248.30
August	278.00
September	311.25
October	370.05
November	397.40
December	438.35
	3980.25
Deduct on account of 50 min. extinguishing time	30.25
Total, yr.	3950.00

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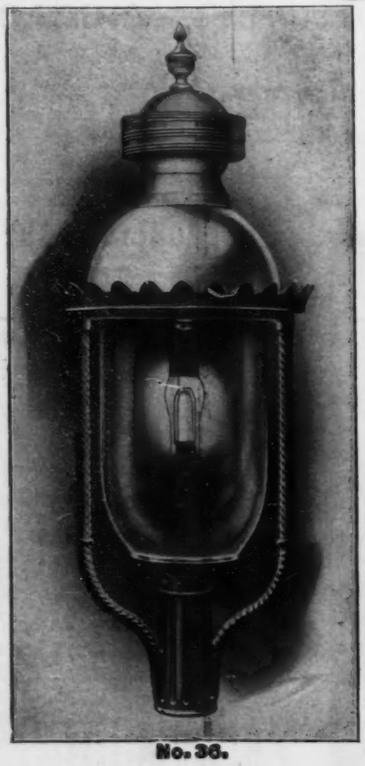
WELSBACH STREET LIGHTING COMPANY



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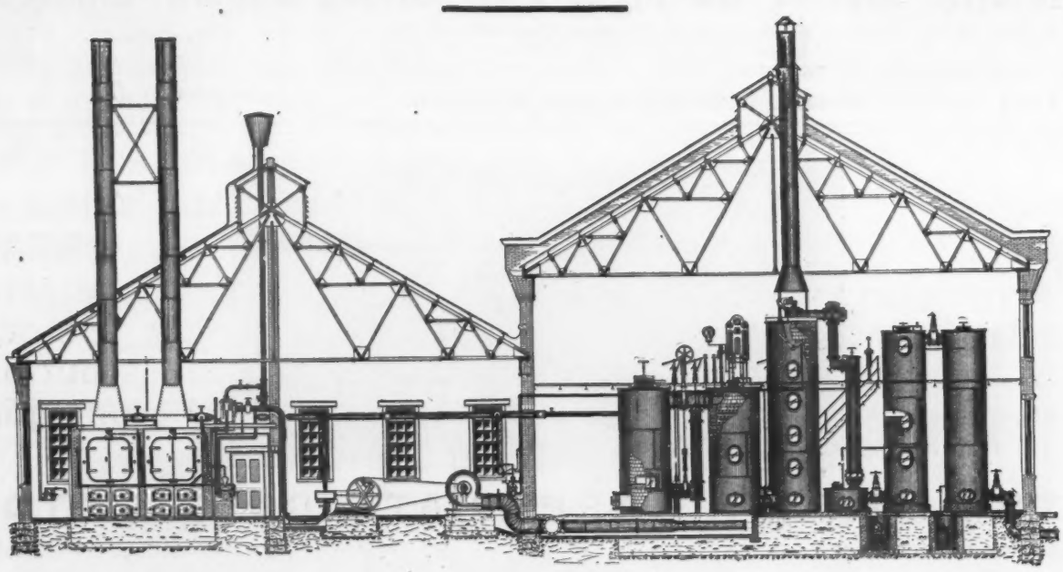

TOTAL SETS INSTALLED TO JULY 1, 1909, ... 704
TOTAL DAILY CAPACITY TO JULY 1, 1909, ... 577,440,000 cu. ft.

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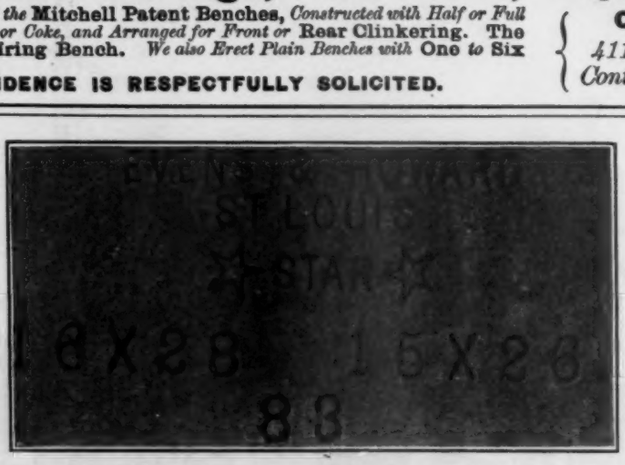

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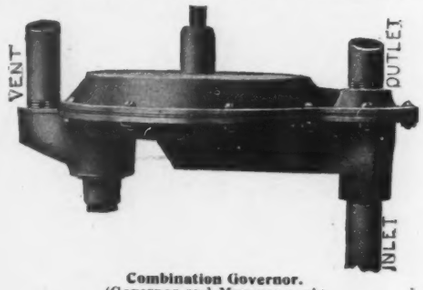

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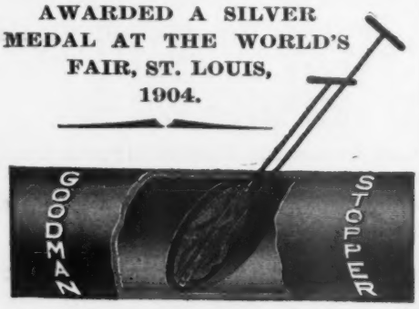

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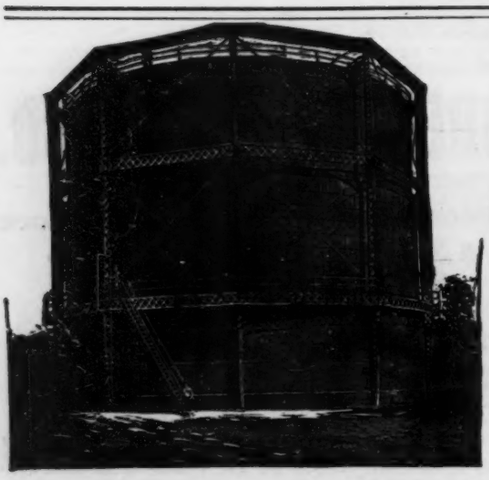

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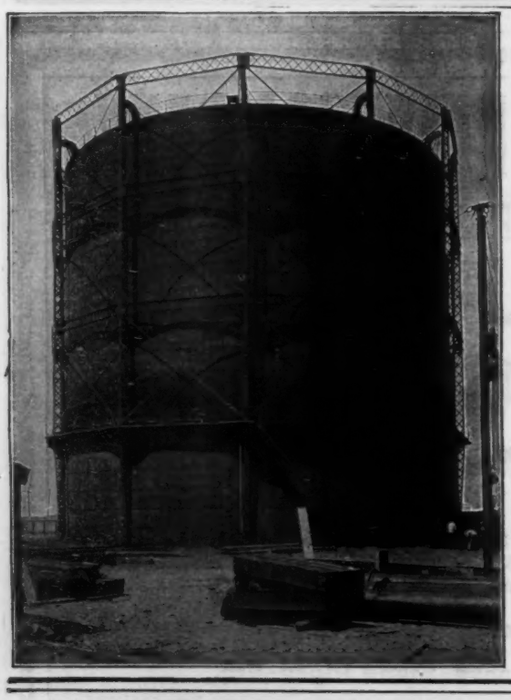

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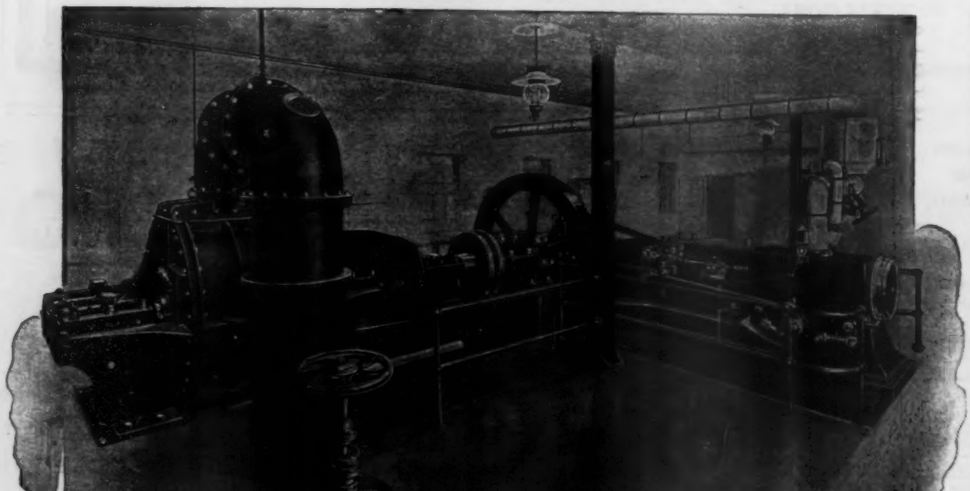

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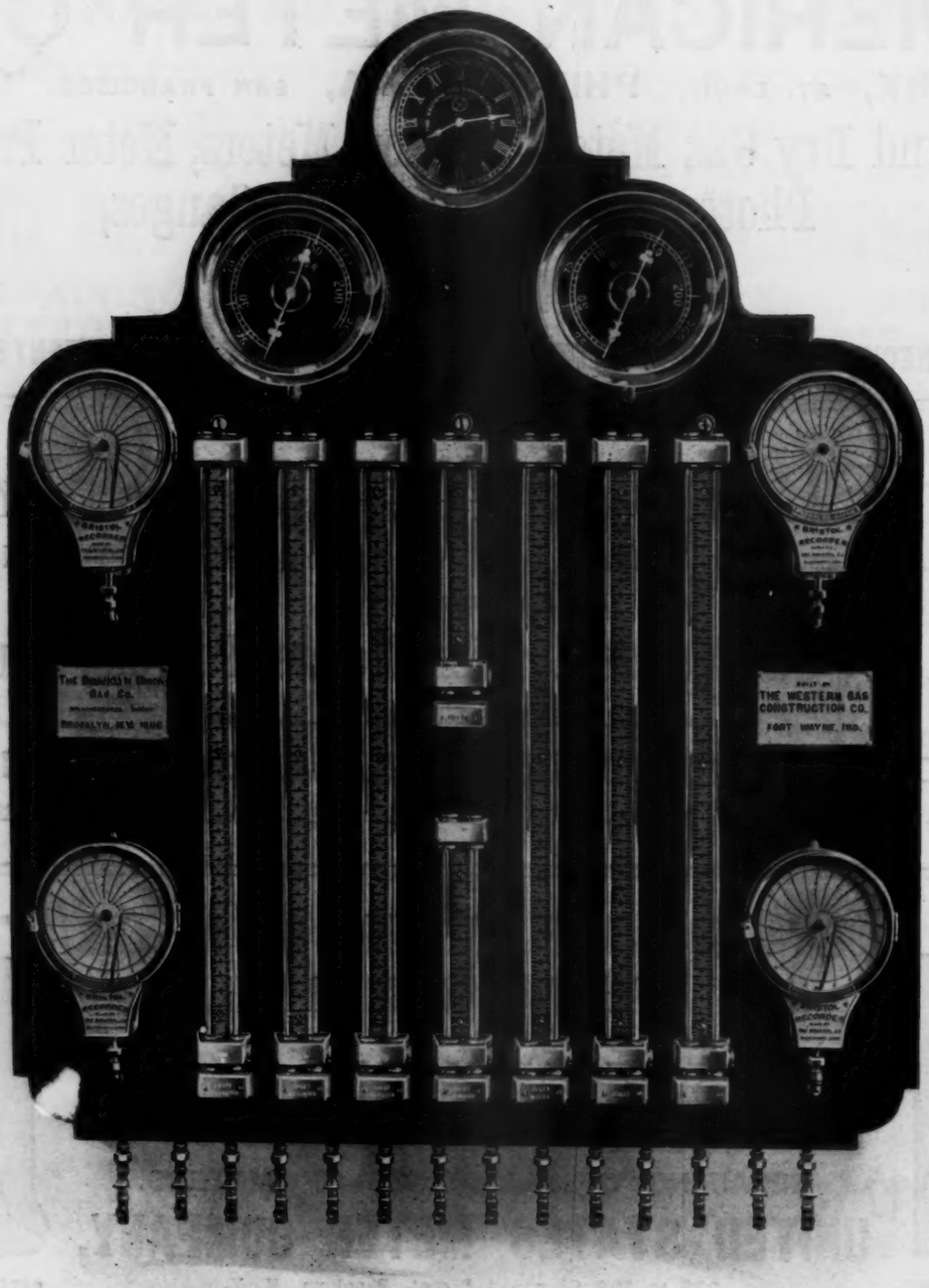

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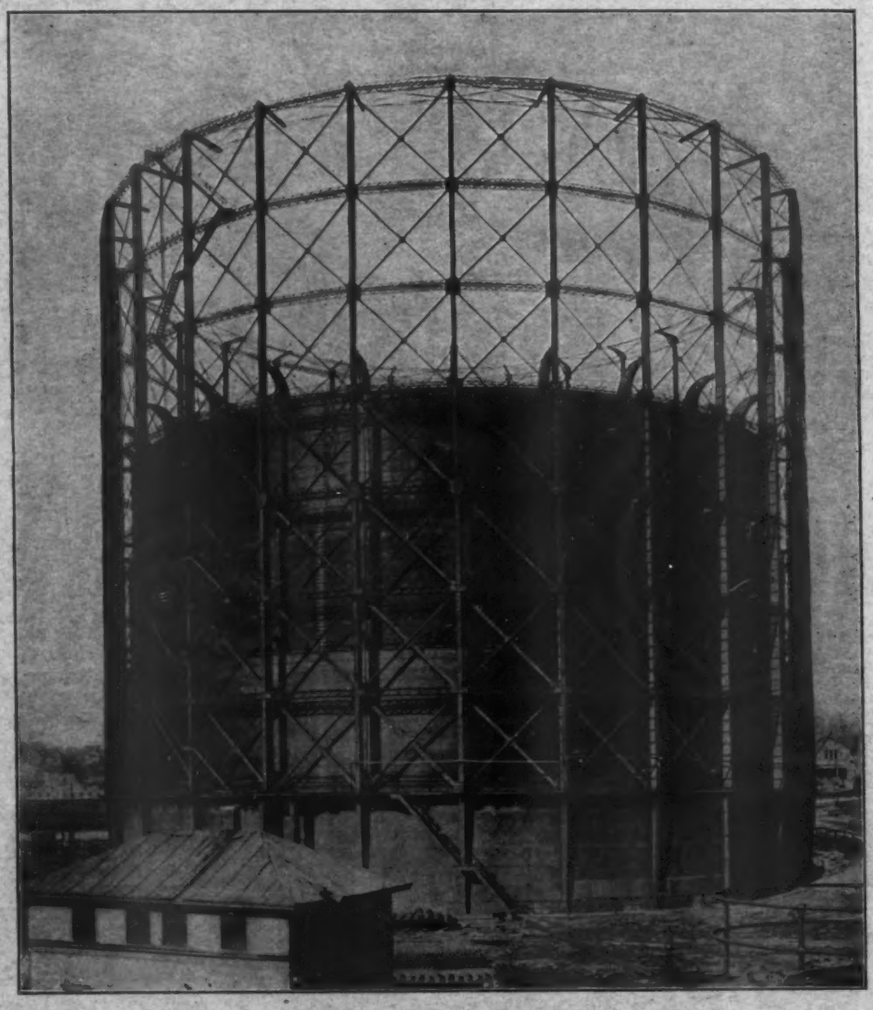

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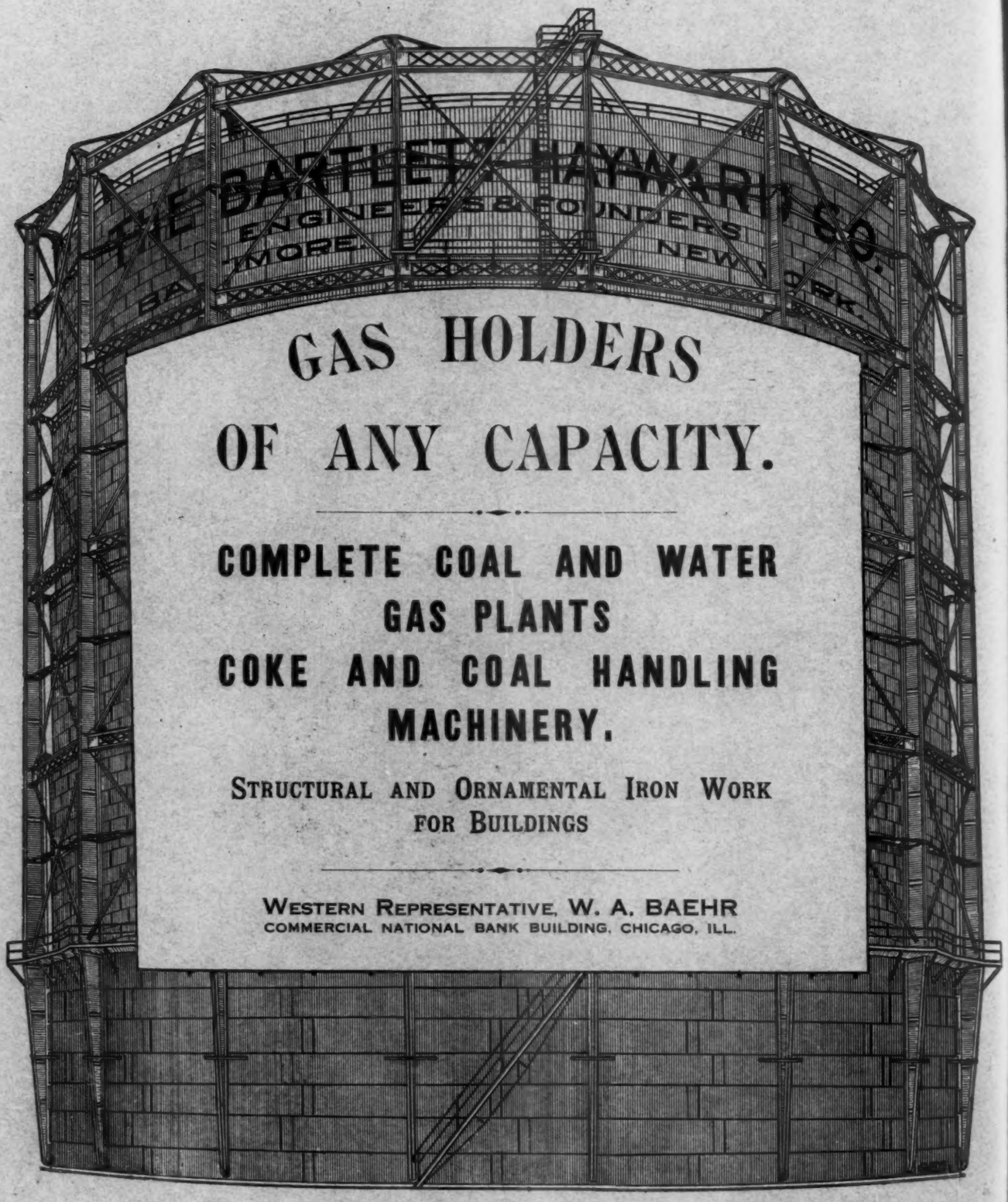

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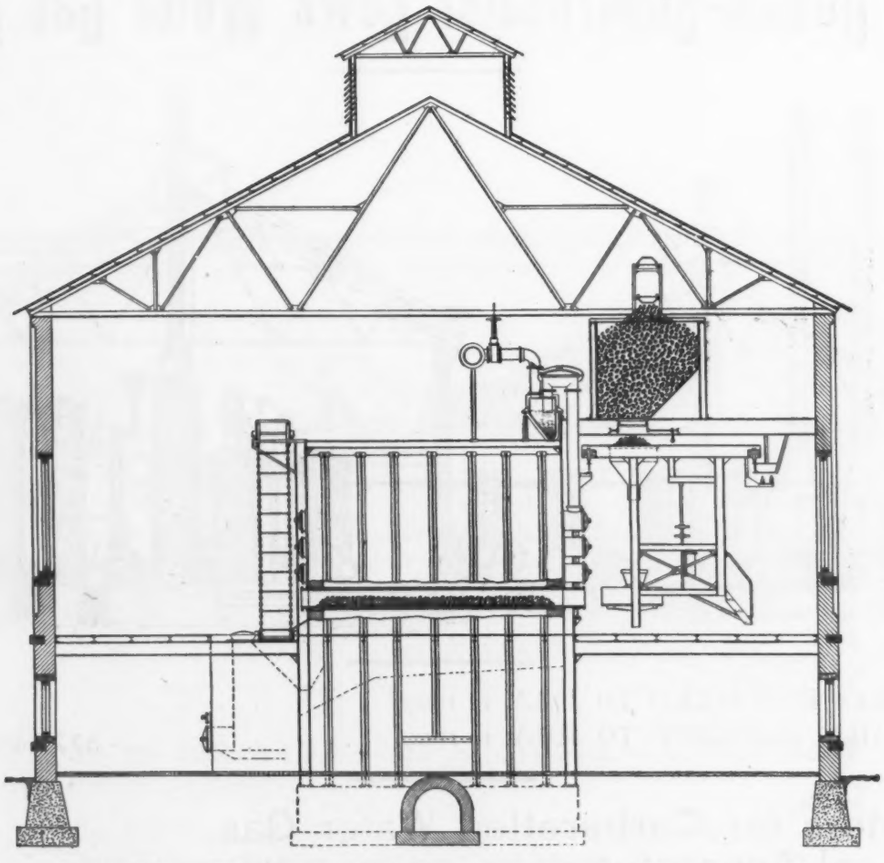

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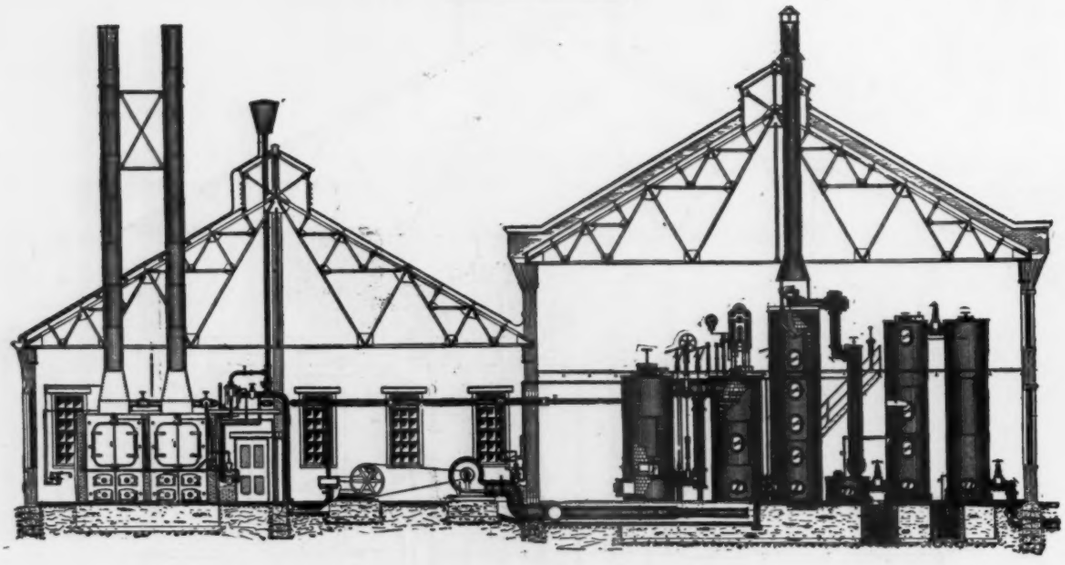

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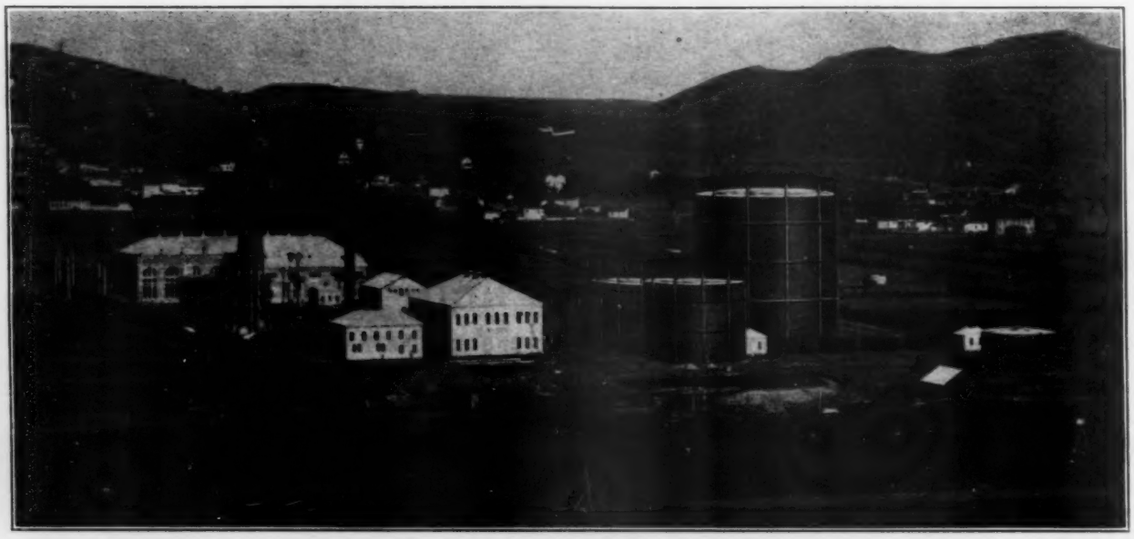

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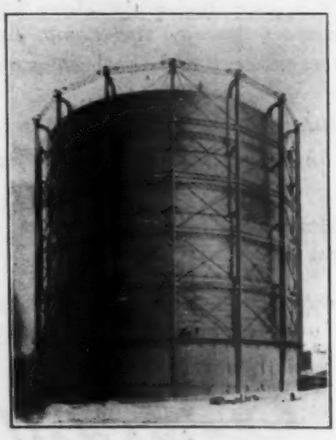

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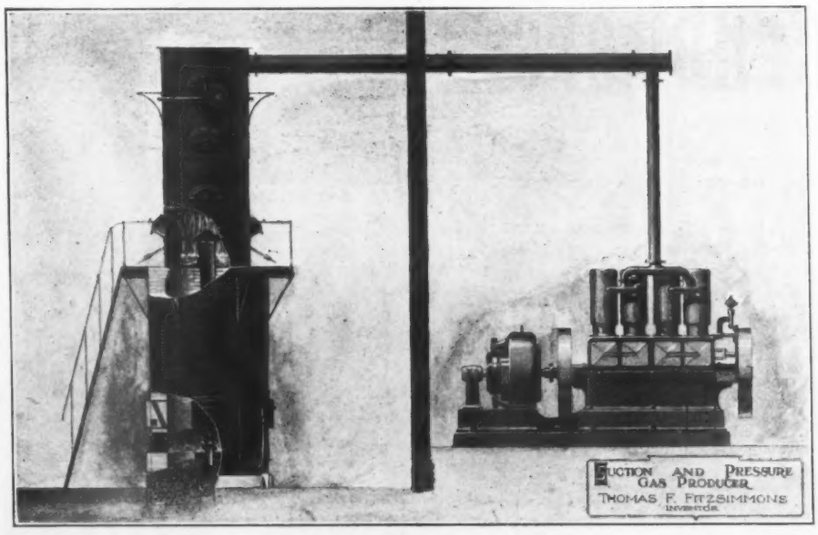

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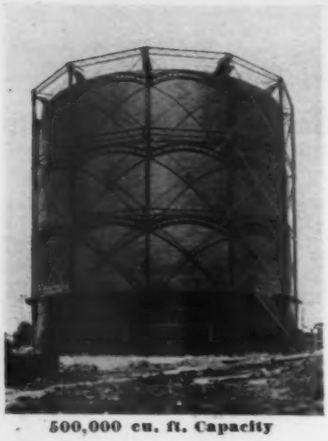

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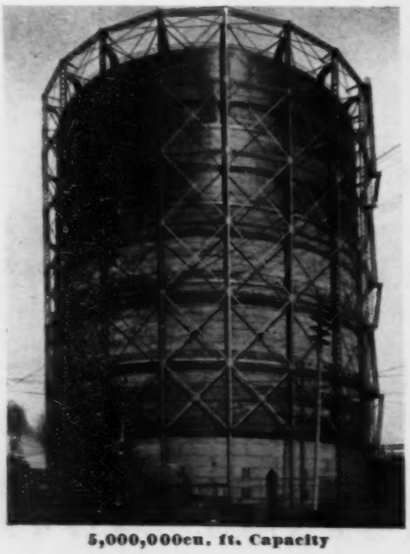

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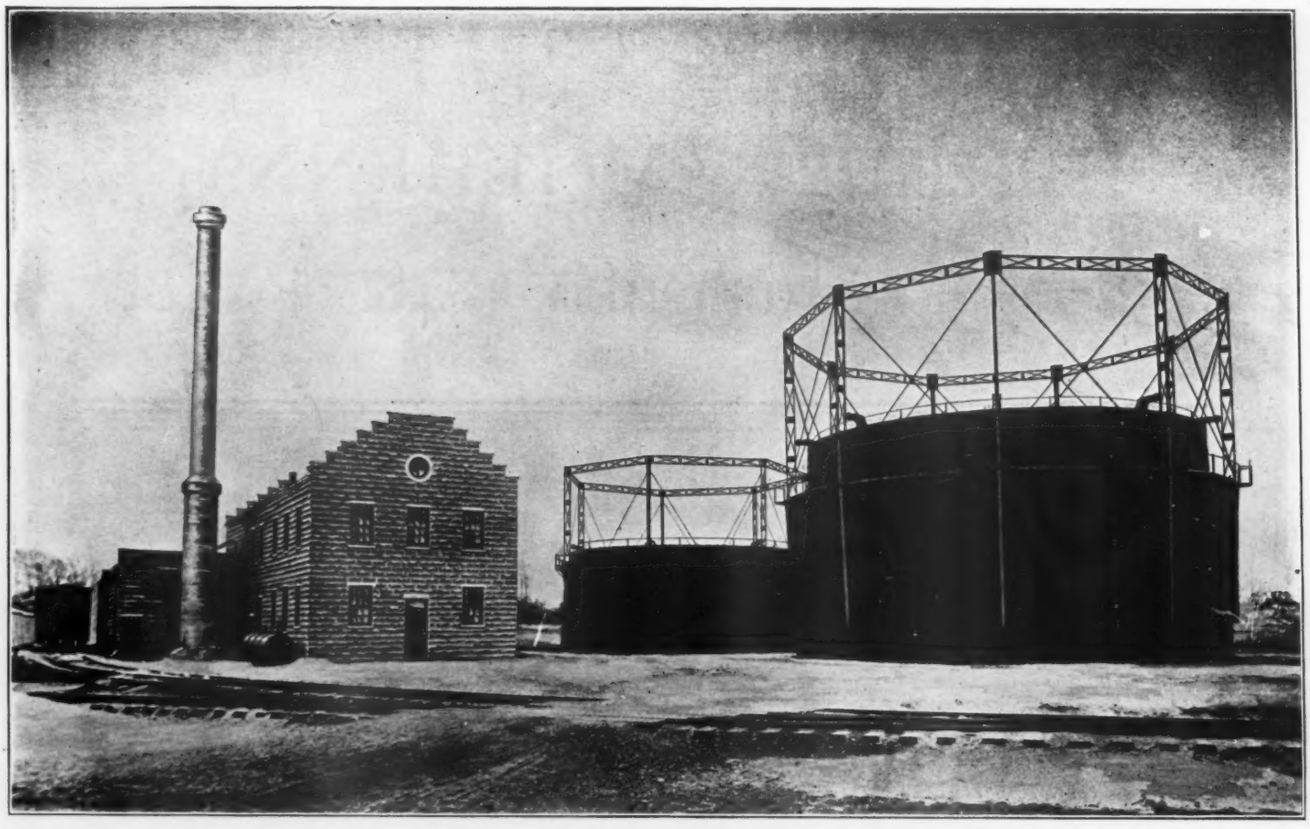

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MANUFACTURERS AND ERECTORS OF

COMPLETE COAL AND WATER GAS WORKS

SPECIALTY—LARGE PURIFIERS

OFFICE AND WORKS, Ingham Ave., TRENTON, N. J.

GAS WORKS BOUGHT AND SOLD

EMPIRE GAS IMPROVEMENT & CONSTRUCTION CO.

BUILDERS OF COMPLETE GAS WORKS

PLANS AND SPECIFICATIONS SUPPLIED

THE LOWE-SUTHERLAND WATER-GAS GENERATOR — THE MOST ECONOMICAL AND MOST EASILY OPERATED IN THE WORLD.

50 CHURCH STREET, HUDSON TERMINAL BUILDINGS NEW YORK

HELME & McILHENNY

ESTABLISHED 1848

MAKERS OF GAS METERS

A TYPE, HIGH CAPACITY,

GAS METERS

PREPAYMENT GAS METERS

THE FOULIS STATION GOVERNOR

1339-1349 CHERRY STREET

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1855 D. & H. McDonald 1857

1857 D. McDonald & Co. 1909

GAS METERS

Consumers Dry Meters

Prepayment Meters *Station Meters*

METER PROVERS GAUGES

D. McDONALD & CO.

ALBANY, N. Y.

NEW YORK CHICAGO

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METERS

INCREASED CAPACITY INCREASED EFFICIENCY

Prepayment Meters *Station Meters*

Meter Provers, Etc.

Prompt and Careful Attention to all REPAIR WORK

MARYLAND METER COMPANY

BALTIMORE CHICAGO

You NEED One or More of Our COMPLAINT METERS

Nathaniel Tufts Meter Company

455 Commercial Street

BOSTON

THE COST OF MAINTENANCE OF YOUR METER REPAIR SHOP IS GREATLY REDUCED BY USING

IMPROVED REGULAR AND PREPAYMENT METERS

POINTS OF EXCELLENCE

LEAKS AT CONE OF METERS ABSOLUTELY ELIMINATED BY OUR ONE PIECE BRASS TUBE SCREW AND PIPE RIVETED TO THE METER.

EXTRA HEAVY TIN PLATE USED—BOTTOMS OF METERS MADE OF DOUBLE THICKNESS TIN PLATE, PROLONGING THE LIFE OF METERS.

REINFORCED CONSTRUCTION AND PERFECT DIAPHRAGMS.

THEY REPRESENT THE FARTHEST ADVANCE IN GAS METER CONSTRUCTION, AND ARE MADE A LITTLE BETTER THAN SEEMS NECESSARY.

NEW YORK IMPROVED METER CO.

Pacific Coast Representative
THE NORTHWEST GAS EQUIPMENT CO.
Portland, Oregon

306-308-310 East 47th Street
NEW YORK CITY

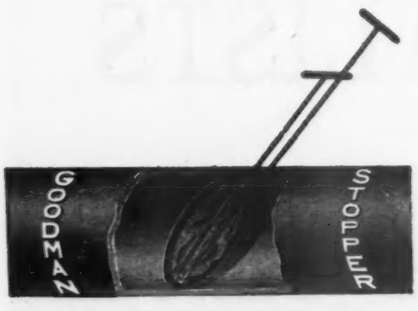
AMERICAN METER CO.,

NEW YORK, ST. LOUIS, PHILADELPHIA, SAN FRANCISCO, CHICAGO,

Wet and Dry Gas Meters, Station Meters, Meter Provers, Photometrical Apparatus, Gauges,

PREPAYMENT METERS,

REGULAR METERS REFITTED WITH PREPAYMENT ATTACHMENTS.



AWARDED A SILVER MEDAL
AT THE WORLD'S FAIR, ST. LOUIS, 1904

AGENTS

Pacific Coast
VAN E. BRITTON, - 269 Monadnock Bldg., San Francisco, Cal.

Great Britain
PARKER & LESTER, - - - Old Kent Road, London

MANUFACTURED BY

SAFETY GAS MAIN STOPPER CO.

257-263 East 133d Street, - - NEW YORK CITY

BALTIMORE RETORT AND FIRE BRICK CO.

"THE BEST BY TEST"

BALTIMORE, MD.

GAS BENCHES

HORIZONTAL, INCLINED OR VERTICAL RETORTS

= MOST DURABLE CONSTRUCTION =

= MOST EFFICIENT SYSTEMS =

COMPLETE EQUIPMENTS WITH COAL AND COKE HANDLING MACHINERY

WALDO BROS., Boston, Mass., NEW ENGLAND AGENTS

L. C. HAMLINK, President GEO. F. VATER, Engineer and Chemist AUGUST COURT, Secretary

Gas Bench Construction Co.

ST. LOUIS, MO.

BENCH SPECIALISTS

WE BUILD GUARANTEED BENCHES

HORIZONTAL, VERTICAL, INCLINED.

ALL STYLES ALL SIZES

1844 1909

LACLEDE FIRE BRICK MFG. CO.,
ESTABLISHED 1844

CHRISTY FIRE CLAY CO.,
ESTABLISHED 1857

"LACLEDE-CHRISTY"
MERGED 1907

IN OUR **65 YEARS** EXPERIENCE
WE HAVE ATTAINED THE ACME OF EXCELLENCE
IN THE PRODUCTION OF FIRE CLAY
AND VITRIFIED CLAY PRODUCTS

PIONEERS AND LEADERS IN THE MANUFACTURE OF **GAS RETORTS BENCH SETTINGS WATER GAS LININGS**

WE WERE THE **FIRST** AMERICAN MANUFACTURERS
TO BUILD A RECUPERATIVE BENCH

WE WERE THE **FIRST** AMERICAN MANUFACTURERS
TO BUILD A BENCH OF INCLINES

WE WERE THE **FIRST** AMERICAN MANUFACTURERS
TO BUILD A BENCH OF VERTICALS

LACLEDE-CHRISTY CLAY PRODUCTS COMPANY
ST. LOUIS, MISSOURI.

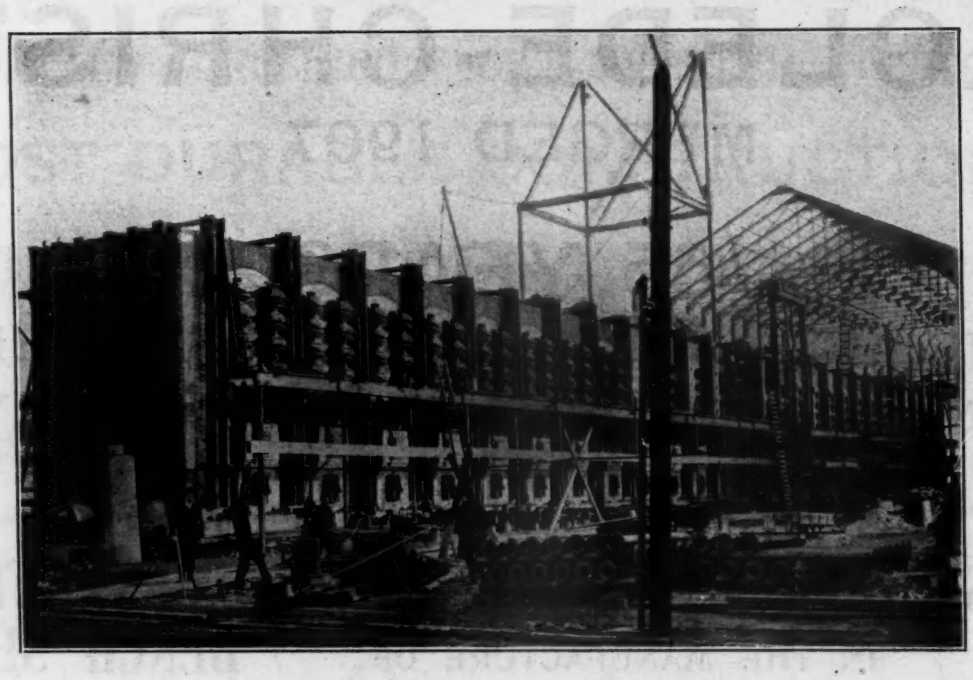
1844 1909

The Parker-Russell Mining & Mfg. Co.

St. Louis, Missouri. New York Office, 45 Broadway.

GAS RETORT BENCHES, HORIZONTALS, VERTICALS, INCLINES, STOKING MACHINERY.

You don't have to wait for Us. Where necessary, we build in the open.



Fifty arches and benches of eights built for the Cincinnati, Gas & Elec. Co. in 1905.

STOKING MACHINERY FIDDES ALDRIDGE ONE STROKE MACHINE

Charging 20 ft. through retorts while discharging the coke.

Installed within the last four years at Bristol, Liverpool, Wrexham, Peterborough, Coventry, Leicester, Birmingham, Southend, Fulham, Ilkeston, Merthyr Tydfil, Newport, Strasburg, Rotterdam, Antwerp, Buenos Ayres, Valparaiso. Under contract for Manchester, Bolton, Eng., Turin, Italy.

Twenty-six machines in use.

No dust. No noise. Lowest cost of operation and repairs. Operated with continuous overhead bins, or provided with hoppers to carry the coal.

BENCHES — Horizontals with through or closed end retorts. Most efficient and strongest construction on the market.

VERTICALS — Agents for the West for the Woodall-Duckham vertical benches for continuous carbonization. Also build intermittently charged vertical benches.

SLOPERS — Inclined benches with any number of retorts of varying lengths.

IRON WORK — All bench mountings of our own design, extra heavy.

WATER GAS LININGS — We make high grade linings for all water gas machines.

MATERIALS — **All retorts and settings made from clays mined by us from our own mines. We manufacture all of our own materials. We are independent of other manufacturers. When you deal with us you get the celebrated Parker-Russell goods. None better.**

RETORT HOUSE CONVEYING MACHINERY — We design and build retort houses, coal and coke conveying machinery.

CORRESPONDENCE SOLICITED.

ALL CONTRACTS MADE AS OF SAINT LOUIS.

WE STOP CLINKERS.

FIFTY-TWO BENCHES OF SIXES ALL EQUIPPED WITH THE ECONOMIZER.

THE DOHERTY BENCH FUEL ECONOMIZER IS THE GREATEST IMPROVEMENT EFFECTED IN COAL GAS BENCHES IN FIFTY YEARS.

EQUALLY EFFECTIVE WHEN APPLIED TO HORIZONTALS, INCLINES OR VERTICALS.

GUARANTEED UNDER PENALTY TO
- ABSOLUTELY PREVENT CLINKERS
- SAVE FUEL
- INCREASE CARBONIZING CAPACITY
- REDUCE BENCH REPAIRS
- PROLONG LIFE OF BENCHES

COMPLETE NEW BENCHES OR REFILLINGS.

THE IMPROVED EQUIPMENT CO.

DESIGNERS—BUILDERS

MAIN OFFICES: 60 Wall Street, -:- -:- -:- NEW YORK, N. Y.

SOLE LICENSEES FOR THE DOHERTY BENCH FUEL ECONOMIZER.

For More Than 50 Years

we have been making only the best fire-clay material. We reprint some letters which were published in our 1885 catalogue. Our friends are assured we have not been content to rest on our laurels, but are making even better retorts and bench material than in the past. :=: :=: :=:

CHICAGO, January 10, 1879.

MESSRS. EVENS & HOWARD.

Gentlemen:—If a few lines from me would be of any benefit to you, giving testimony in favor of your goods, you are welcome to them.

We have been using your make of Fire Bricks for about twenty years; Retorts and Tiles not less than five or six years.

Within the last-named period you have sent us more than 400 Retorts, with Tiles, etc., for setting the same.

In 1874, when we built our new gas works, it was decided to put in eight benches of Retorts each, of four different makes, to test the durability and refractory power of all under like conditions, and whilst all gave very general satisfaction, yours proved the best and most durable, sinch which time the largest part of our orders have been sent to your firm.

I regard your goods equal to any made in the country, and cheerfully recommend them to all who will pay a liberal price for a good article.

Yours respectfully,
(signed) P. T. BURTIS,
Engr. & Supt.,
Chicago Gas Light & Coke Co.

NEW ORLEANS GAS LIGHT COMPANY,
NEW ORLEANS, March 13, 1875.

MESSRS. EVENS & HOWARD,

Gentlemen:—Yours of the 5th instant is received. We have been using your Cheltenham Fire Clay for five years, both for mortar and retort setting, tiles and blocks, with great satisfaction. The blocks have stood as well as any of the numerous brands which we have tested.

We have also used your Cheltenham Fire Bricks for several years, and have found them to possess remarkable refractory power. In one instance an arch of these bricks, turned directly over the center of a retort furnace, was taken down after having been continuously exposed to a white heat for eighteen months, and the only sign of the ordeal was a slight glaze upon the surface. Every brick forming the arch was used in a new furnace.

(signed,) THEOBALD FORSTALL,
Genl. Supt.

CINCINNATI, OHIO, Jan. 10, 1879.

MESSRS. EVENS & HOWARD,

Gentlemen:—Your communication of the 7th inst. at hand, and in reply thereto would state that, of the 170 Retorts furnished by you, we have had in use for the past sixteen months two Benches of sixes fired with tar. They have given entire satisfaction in every respect.

I consider your Retorts and Tiles equal, if not superior. to any other make.

Respectfully,
(signed,) J. FULLAGAR,
Supt. Gas Works.

OFFICE LACLEDE GAS WORKS,
ST. LOUIS, March 5, 1885.

MESSRS. EVANS & HOWARD,

Gentlemen:—I have tested your Carbon Pipe sent me, and have used this one set in nineteen different retorts, and found them to stand the test better than any I have used heretofore.

I tested them in different ways, and found them to work without cracking when cooled off, and they seem as good as when I first started to test them.

Yours truly,
(signed,) J. C. ZABRISKIE,
Superintendent.

INDIANAPOLIS, IND., March 6, 1889.

MESSRS. EVENS & HOWARD,

Gentlemen:—Your favor of the 5th instant is received. I have used your Carbon Pipes for several years with highly satisfactory results.

Yours very truly,
(signed,) JAMES SOMERVILLE,
Engr. & Supt.
Indianapolis Gas Light & Coke Co.

GAS WORKS DIVISION

A. S. B. LITTLE, Engineer

FRED BREDEL COMPANY

FRED BREDEL, C. E., President — MILWAUKEE, WIS.

DESIGNERS and BUILDERS of COAL GAS WORKS and APPARATUS

BREDEL Recuperative Benches with Chamber Recuperator; all sizes, either Horizontal or Inclines.

Retort House with 20 Benches of 9's, Charging and Drawing Machines, Hydraulic Coke Conveyor. Erected for the Richmond City Gas Works. ALL OUR OWN SYSTEM.

Our Benches use less fuel and last longer than any other bench, without exception.

NAPHTHALENE EXTRACTOR CONDENSERS
NAPHTHALENE WASHERS
TAR WASHERS
AMMONIA WASHERS
COOLERS
PURIFIERS, AMMONIA STILLS
GAS ENRICHING PLANTS
RETORT HOUSES, STAGE FLOORS
TURN TABLES

BREDEL-FOULIS DISCHARGING MACHINE
SOLE AGENTS FOR
ARROL-FOULIS CHARGING MACHINE, and
FROHNHAUSER COKE CONVEYOR

Complete Gas Purifying Plants to use in conjunction with high percentage Sulphur Coal. Patented System in Actual Operation

THE CHAMBER OVEN COMPANY, 405 KEENE STREET MILWAUKEE, WIS.

Fred Bredel, C. E., Pres.

BUILDERS OF

CHAMBER OVENS

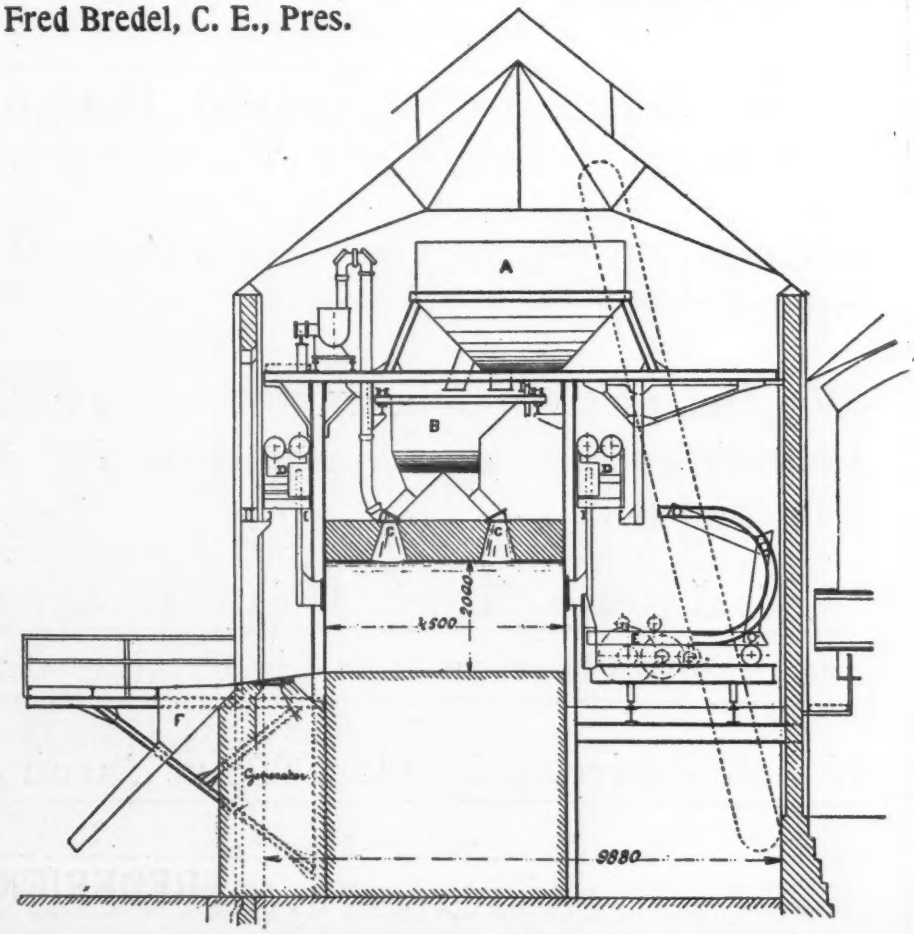
Horizontal, Vertical and Inclined

All Three Types in Actual Operation
No Experiments

"ADVANTAGES"
More Gas, More Ammonia, More Tar
Better Coke. LABOR MINIMUM

No attention required nor work done during the night

Cost of installation will pay for itself in short time, and is less than for Vertical Retorts



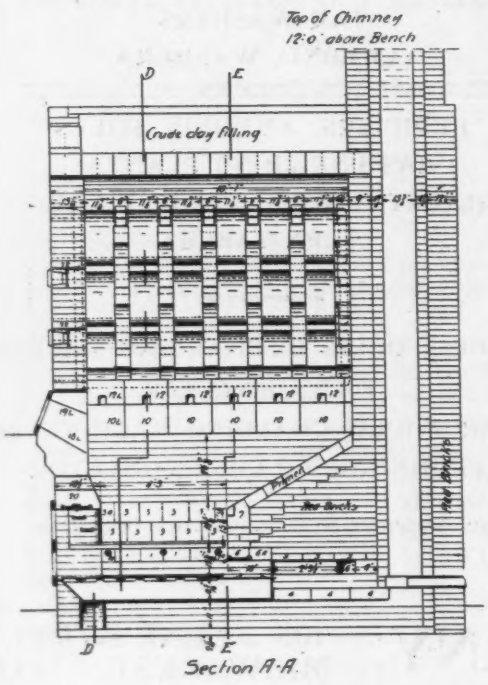
COST OF LABOR LESS THAN VERTICAL RETORTS

DIDIER-MARCH COMPANY

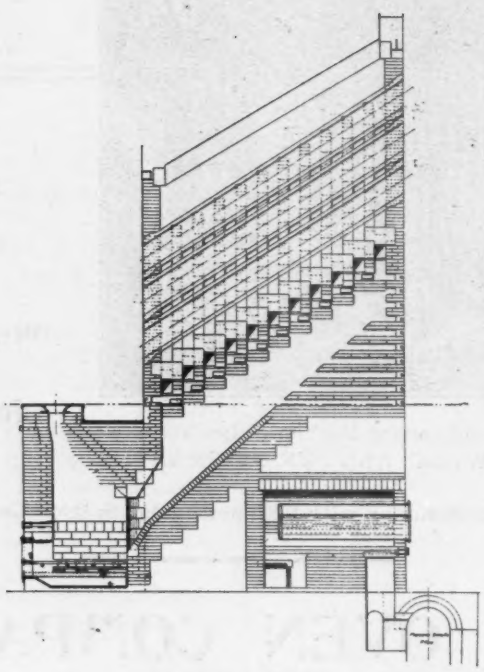
Hudson Terminal Building

Works
Keasbey, Perth Amboy, N. J.

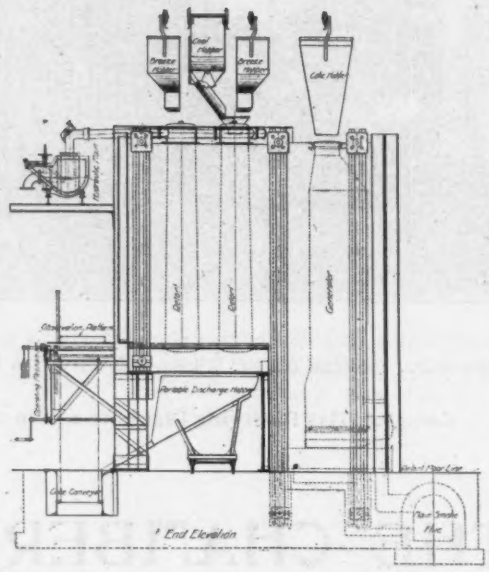
50 Church Street
New York, N. Y.



HORIZONTAL



INCLINED



VERTICAL

Retort Benches of Approved Design and Construction with Horizontal, Inclined and Vertical Retorts.

Linings for Water Gas Generators, Tiles and Fire Bricks for Specific Purposes.

We Design and Construct Complete Coal Carbonizing Plants, Including Coal and Coke Handling Machinery in Connection Therewith.

Vertical Retort Benches of the Dessau System with 4000 Retorts are now in Operation and in Course of Construction.

If You Desire to Increase Your Earning Capacity, Consult Us.

FREDERICK J. MAYER, Gen'l Manager

GAS RETORT BENCHES OF EVERY DESCRIPTION

CONSTRUCTED BY US OF THE

MOST REFRACTORY MATERIALS

FOR EASE OF OPERATION, HIGH YIELD, AND LOW FUEL CONSUMPTION,

ARE NOT EXCELLED

THROUGH BENCHES OF SIXES, EIGHTS OR NINES, RETORTS UP TO TWENTY FEET IN LENGTH, OPERATED ON ONE FURNACE

J. H. GAUTIER & COMPANY

JERSEY CITY, N. J.

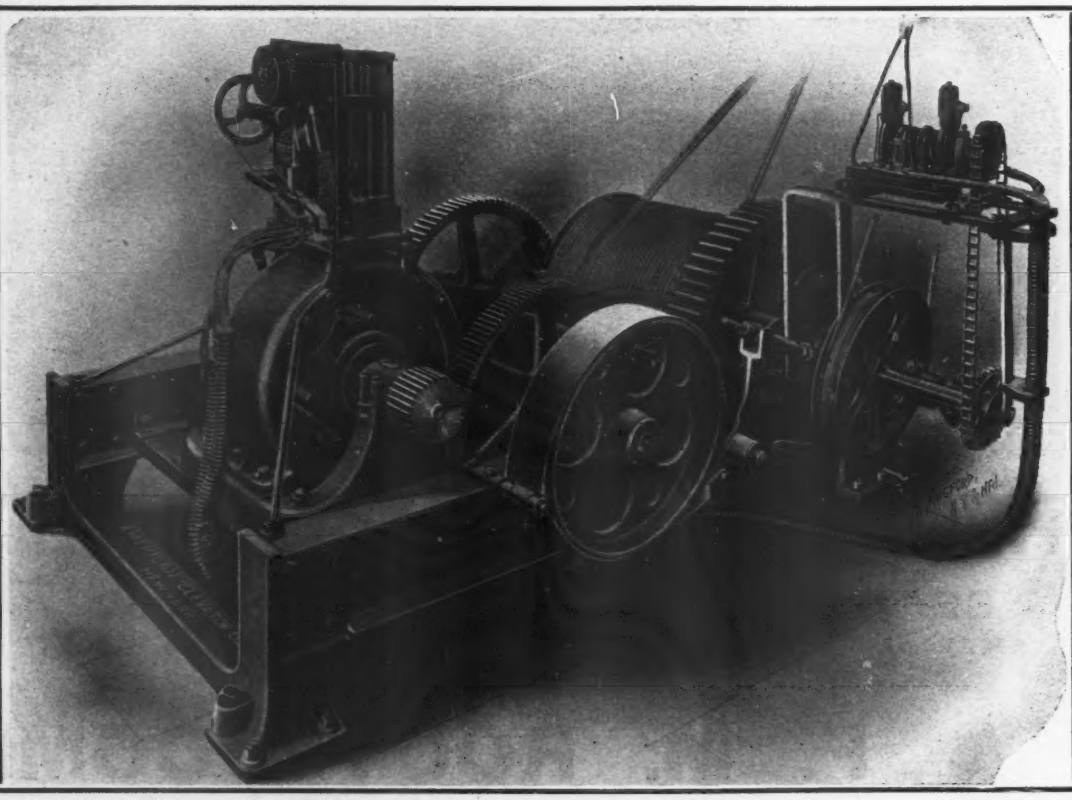
MANUFACTURERS OF HIGH GRADE FIRE CLAY PRODUCTS FOR FIFTY YEARS

THE CUT BELOW SHOWS THE MOST EFFICIENT FREIGHT

ELEVATOR MACHINE

BUILT FOR CAPACITIES UP TO 20,000 LBS. and SPEEDS TO 100 FEET PER MINUTE

We build BELT POWER ELEVATORS FOR FREIGHT SERVICE



We build High-Grade PASSENGER ELEVATORS

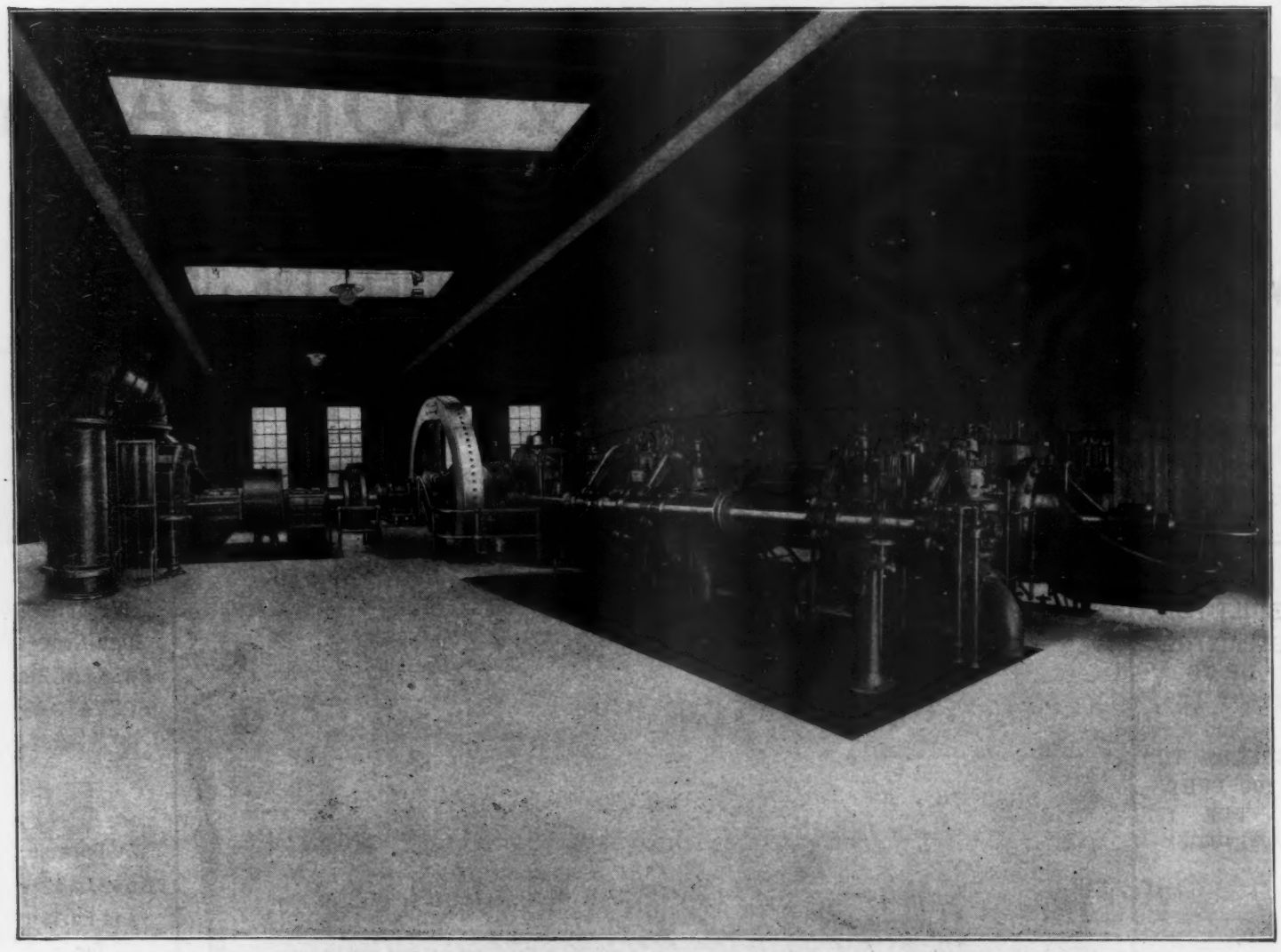
We Furnish New Cables and Parts for STEAM, HYDRAULIC, ELECTRIC, and BELTED ELEVATORS

AMERICAN ELEVATOR COMPANY

113-117 CEDAR STREET, - - NEW YORK, N. Y.

50TH ANNIVERSARY
ROOTS EXHAUSTERS

SINCE 1859 WE HAVE STOOD IN THE LEAD IN THE MANUFACTURE OF GAS EXHAUSTERS AND OUR PRODUCT TO-DAY IS THE MODEL THAT ALL OTHERS ASPIRE TO.



OUR FIFTIETH ANNIVERSARY INSTALLATION

SEE DESCRIPTION ON PAGE 1062
AMERICAN GAS LIGHT JOURNAL ISSUE, JUNE 14, 1909

P. H. & F. M. ROOTS COMPANY

HOME OFFICE, CONNERSVILLE, IND.

New York Office, 120-122 Liberty St. Chicago Office, 1547 Marquette Bldg.

THE AMERICAN GAS LIGHT JOURNAL

PUBLISHING OFFICE No. 42 PINE STREET

DEVOTED TO THE INTERESTS OF ILLUMINATION, HEATING, MECHANICAL, CHEMICAL AND GENERAL SCIENCE.

COPYRIGHTED 1909, BY A. M. CALLENDER & COMPANY.

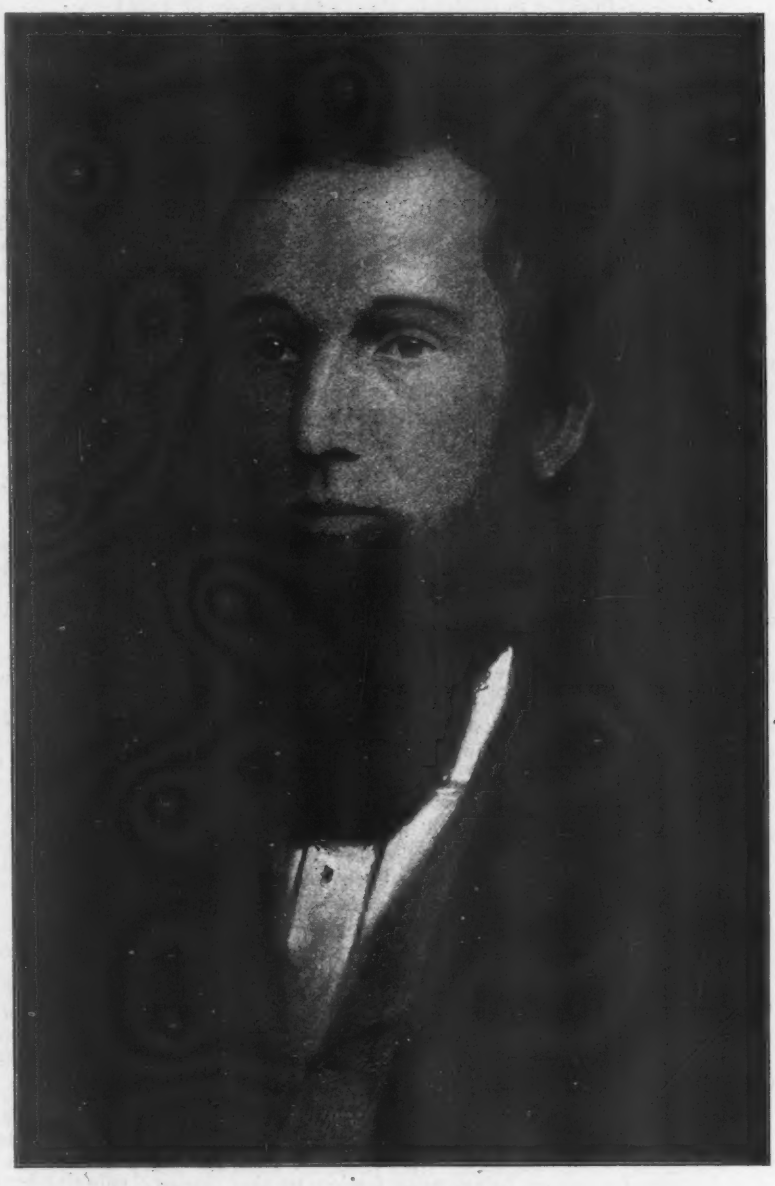
VOL. XCI. NEW YORK, MONDAY, JULY 19, 1909. No. 1780.

A. M. CALLENDER & CO., Proprietors. C. H. WADELTON, Manager.
THOMAS J. CUNNINGHAM and ELBERT P. CALLENDER, Editors.

ENTERED AT THE POST OFFICE AT NEW YORK, N. Y., AS SECOND-CLASS MATTER.

The Story of the Journal.

This month is the one which, 50 years ago, saw the first publication of the JOURNAL, and the reproduction of its title page herewith shows that its beginning in July, 1859, was—well, not an imposing one. The initial editorial so well details the reasons for its birth that it is useless the author's pen should go lengthily into those here and now. It might be said, however, that its proprietors, Messrs. John B. Murray & Co., whose banking quarters, strange to say, were in 40 Wall Street, hardly a stone's throw from our present quarters, 42 Pine Street, and the said 40 Wall Street even today is noted in the gas industry, since it affords an office home to the United Gas and Electric Company, the engineering destinies of which are so well directed by our long-time contemporary, the genial "Ed." E. Witherby. The time must have been ripe for such a publication, but it was born in the shadow of a period which, live the world as it can for years that may stretch to the end of Time's tension, will be remembered of men. The ominous clash that was to be marked forever in history as the War of the Rebellion, was far too kind by portents that were unmistakably those of ravage; but the Murray forces would not be restrained and the JOURNAL went on its way with increasing recognition from the trade. Oddly enough, although originally intended to lean more towards the stock and bond or capitalizing division of the industry, nevertheless its warmest and best supporters from the outset were those actually engaged in the art of constructing the gas plants and manufacturing the gas. The personnel of the editorial direction in those days was pretty well centered, and although invariably all of the credit in those lines was taken by Mr. J. B. Murray, there is little doubt that much of the literary direction fell upon Dr. John Torrey, Assayist of the United States Mint, and Prof. Henry Wurtz, then prominent in the workings of the Patent Office in Washington, in which division he figured well up as an Examiner. On January 1st, 1860, the offices of the publication removed to 254 Canal Street, East, or between Broadway and Center Streets. Virtually, this some years prior was the site of the old New York gas works—the company operating which was the pioneer. Eventually in these quarters the proprietors took on the idea that a continuous exhibition of gas appliances—which in those days were far from many—"from a Scotch tip to a blow pipe" in the Canal Street premises would be profitable. We feel, however, that these exhibitions were neither patronized nor profitable. July 2, 1860, beheld the publication of the first number of the JOURNAL as a semi-monthly publication — the proprietorship and place of business remaining unchanged. The publishers' announcement was that the dates of publication would be the first and fifteenth days of each month. At which quite an addition was made to the size of the page of the paper, the range roughly being increases of one inch and two inches, respectively, in the width and depth of the page; the book itself carried 16 pages. It is also worthy of note that the JOURNAL was carrying in its pages a list of the companies that had been granted charters up to date, and the tablings further carried information about of as much value as that carried in the gas directories of the present day. As an example we may quote from the leading editorial of the issue dated July 16, 1860, a reference summary to the companies listed:



MILLS L. CALLENDER.

Place of Companies.	No.	Capital.
American	381	$47,911,215
British Provinces	23	2,112,040
Cuba, Mexico and South America	19	6,500,000

THE

AMERICAN GAS-LIGHT JOURNAL.

JOHN B. MURRAY & CO., BANKERS, NO. 40 WALL STREET, NEW YORK CITY,

PROPRIETORS.

No. 1. NEW YORK, FRIDAY, JULY 1, 1859. $3 PER ANNUM. PUBLISHED MONTHLY.

OUR FIRST NUMBER.

Of this, our first number, we issue ten thousand copies, which will be forwarded to subscribers and otherwise distributed in all the cities and towns of the Union, among Gas-Light and Water Companies, their Shareholders and Contractors, and among Banks, Bankers, Merchants, Manufacturers, and owners of Real Estate.

Our sheet was intended originally, and, indeed, prepared to be set up, as a private circular—a mere Price Current of the Gas Light Shares of a few of the principal cities—for gratuitous distribution, monthly, to our own correspondents and dealers; but while in the course of preparation, in the early part of June, we were solicited to enlarge the sphere of our plans, by embracing all the American companies, together with such details as would enable parties interested to compare notes, and avail themselves of every means of improvement, economy, and profit. We acceded to this request, and a sheet of four pages was soon ready to be issued. Others then expressed a desire to adopt this medium of advertising their business to companies and individuals engaged in the manufacture and consumption of gas, as being more direct than any now existing.

Yielding to all these suggestions, we present THE AMERICAN GAS-LIGHT JOURNAL, as the first paper, however small and inconsiderable, ever published in this country, identified with that important interest, the magnitude of which is illustrated by the footings of our tables, showing 183 Companies to represent an aggregate capital of thirty-one million six hundred and sixty-one thousand five hundred and seventy dollars, while we have not more, perhaps, than two-thirds of all the Companies yet registered. We hope, however, to secure a complete List before our second number goes to press, when we think the grand aggregate will foot up four hundred Gas-Light Companies, representing a gross Capital of fifty, perhaps fifty-five, millions of dollars!

That so large and diffusely scattered an interest should have been left till this day unrepresented by a paper of its own, is indeed surprising in this protective age, and it was our only ambition in assuming the labor and responsibility of it, to place before our friends and correspondents, in an authentic form, a sound and reliable security for the investment of their funds, which have been left hitherto measurably to our own discretion. They have now the means of judging for themselves. We did not expect to profit by the JOURNAL otherwise than indirectly, as an auxiliary to our regular banking and brokerage business; but we have the pleasure to state that, so fully has it met the approval of those to whom the prospectus has been submitted, it goes forth at its first number a SELF-SUSTAINING PAPER—an unusual case, we believe, for a new publication on a comparatively unconsidered subject.

We have been long satisfied of the superiority of Gas-light shares as an investment, over any other corporate security, especially since the crisis of 1857, which, while it crushed railroad and many other securities completely, may have tended to diminish, for the few months of that winter, the consumption of gas in large warehouses and manufactories; but it operated, on the other hand, to augment its profits by the depreciation in the cost of coal, iron, building material and labor.

The impetus given now to commerce throughout the length and breadth of the land, has more than equalized the temporary deficiency alluded to. Instance the old New York Gas-light Co., the pioneer on this island, which has steadily paid its eight and ten per cent. per annum for many a long year, with an occasional EXTRA DIVIDEND of ten per cent., and now one of TWENTY PER CENT. on the 1st of May last; whose stock has ruled as high as 150 per cent. for months, and for which we offered 175 since the first of June, without finding a seller.

The Manhattan Gas-light Company too, with its capital of four millions, divides regularly ten per cent. per annum, with an occasional extra dividend of ten per cent., and its stock firm at 150; and all this with the price of gas reduced to two dollars and a half per 1,000 cubic feet.

A reference to our Tables will show that the majority of other companies throughout the country pay from 8 to 10 per cent. per annum. Witness the Albany, Auburn, Baltimore, Boston, Bridgeport, Buffalo, Cincinnati, Hartford, Milwaukie, Ottawa, Pittsburgh, Raleigh, Roxbury, Troy, Washington and Wilmington companies—all above par, with the July dividend paid, and that dividend a very liberal one. Other companies, however, have felt very sensibly the diminished consumption, and their shares are depreciated correspondingly; but the returns from all speak now quite cheeringly of their prospects, and investments in some of these depreciated shares will pay large and certain profits. We shall take up hereafter the entire List alphabetically, and give full particulars of each company as soon as our complete organization will permit. We are arranging with a gentleman of scientific attainments, practically conversant with the business, to conduct the editorial part of the JOURNAL, our own occupations being quite foreign to that department, although identified with the subject as dealers in the securities it represents.

TO CORRESPONDENTS.

We wish to be kept informed of all improvements in the manufacture and circulation of Gas, and of machinery incident to it, and will publish with pleasure any communications on the subject, duly authenticated by signature. We will not publish signatures unless desired.

All communications for this JOURNAL should be addressed to JOHN B. MURRAY & CO.,
No. 40 Wall street, New York.

TO ADVERTISERS.

Advertisements—especially those relating to materials used in the manufacture, improvement or distribution of gas, or in the construction of works—should be sent in at once, in order to appear in our second number. Yearly advertisements, $25 to $100, according to the space occupied. SPECIAL ADVERTISEMENTS double these rates. In all cases, the JOURNAL will be served gratis during the continuance of the advertisement. Advertisements of Gas-Fitters, Plumbers and Gas-Fixtures, will be arranged in separate columns for Albany, Buffalo, St. Louis, Mobile, Philadelphia, Boston, Baltimore, New Orleans, and other places. The circulation of the JOURNAL, in all the cities and towns where gas-light is used, will render it a desirable medium for local advertising of that description.

TO POST-MASTERS.

Post-Masters and others who remit us Twenty dollars at one time, will receive *eight copies* of the JOURNAL for one year, addressed as they may direct; or for Ten dollars we will send *four copies*. We pre-pay the postage on the JOURNAL in all cases. Please distribute the copies of this number sent herewith.

ADVERTISING is the lever with which, resting on Enterprise as the fulcrum, Commerce moves the world.

TO GAS AND WATER CONSUMERS.

We have had enquiries from several quarters whether our columns will be open to communications and suggestions to, the gas and water companies from consumers and others. Undoubtedly they will. The very object of the JOURNAL is to be a medium of communication between the companies and between the companies and consumers.

MARRIED.

At Hudson, N. Y., on 2d June, by the Rev. Henry Darling, of Philadelphia, CHARLES ROOME, Esq., President of the Manhattan Gas-Light Company, to MARY M. WELLS, daughter of Richard I. Wells, Esq., of the former place.

OFFICIAL.

New York State Inspector of Gas Meters,
OFFICE No. 561 BROADWAY.

The whole number of Gas Meters proved since the new law took effect, 4th May, 1859, is..... 4,620
Daily number proved, about..... 125
Number of proving apparatus used..... 17
Time required in proving, from 10 minutes to 1 hour each.

The meters found incorrect have been about 4 per cent. Nearly all new meters are Rotary or Slide Valve Dry Meters.

The Patent Eccentric Valve will eventually supersede all other kinds.

NEW YORK, June 30, 1859.

GEORGE H. KITCHEN,
State Inspector.

Another interesting fact in connection with the appearance of the JOURNAL as a semi-monthly is that the subscription price ($3.00 per annum) remained unchanged, and it is further noticeable that the advertising patronage was taking on an exceedingly healthy growth. In passing it is up to the writer to chronicle that in addition to the increasing menace of war, the gas industry *per se* was threatened with disaster. Petroleum was making its way and the price for its cheap conversion into an excellent illuminating agent was being fast set by certain refiners in Philadelphia, Hunters Point, New York, and Cleveland, Ohio. However, the projects for new gas works were many. And to show how history repeats itself, the July and August issues of the JOURNAL were quite given over to the "History of Ballooning," the issue for August 1st containing quite a large picture of Montgolfier's celebrated aerial voyage. At about this time a goodly share of attention was being devoted to water supply within the scope of the paper as then described, being related to "Light, Heat, Water Supply and Sewerage," also breaking out in spots it was seen were frequent references to the manufacture of water gas, more particularly, perhaps, in regard to the Philadelphia happenings over the Sanders system. With the first issue for December came the first official instructions from Proprietor Murray that the paper had an editor, a Mr. C. Elton Buck, who is described as "a young gentleman of some science, whose scientific education has been vouched by Prof. James C. Booth." That he was a clever young man, too, is shown by the improvement in the tone of the JOURNAL's itinerary. It is also worthy of note that on November 21st, 1860, was held an annual meeting of the Gas Light Association of the State of New York, at which 14 companies were represented, of which three were from New York City—the New York, the Manhattan and the Harlem. It is also worthy of note that the President was Mr. William W. Fox, President of the New York Company, and that the Treasurer was General Charles Roome, of the Manhattan. The death of the former is noted a month or so later. He had acceptably filled the position of President of the company since its going into business until March, 1861—a period of 34 years. Another sad thing in the March 1st (1861) number is the notification that "The sale of the Astoria (N. Y.) gas works is postponed to Wednesday next, 6th inst." And then came the fatal gun that boomed its bloody portent the 12th of April, 1861.

CHARLES E. SANDERSON.

Of a certainty New York was not the center that first felt the horrors of those early days in the rebellion, and while the disasters even to death came to many, the lighting industry was not the one that suffered. At the outset, as nearly as could be done at the time, New York turned night into day. In fact, the only places in which the industry really did suffer were those that actually were in the lines of conflict. To a certainty the closing of ports to commerce caused prices for materials used in works operation or works construction to necessarily advance in leaps and bounds and the price of labor seemed out of all reason. So, take it by and larger, the gas industry would not as a whole have suffered especially, at least with other industries, during these times of horrid combat.

Now, in the recording of another shift in our office quarters, which, May 1, 1861, were installed in the premises of No. 39 Nassau Street, corner of Liberty Street, which location was directly opposite the main post offices of the city.

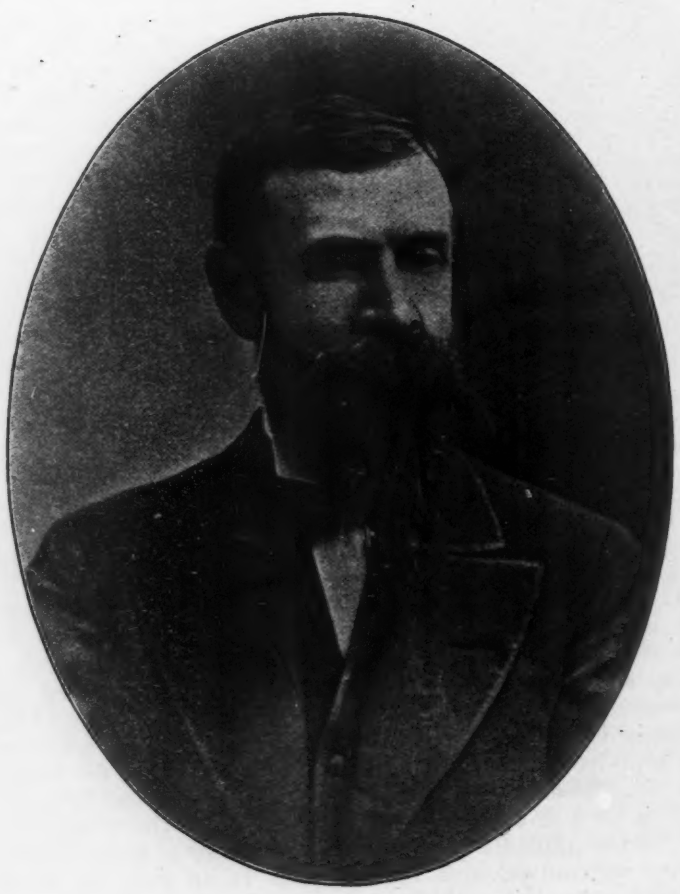
In passing it may be properly recalled here that on June 9, 1861, Charles C. Smith, Secretary of the Boston Gas Light Company, issued a circular letter to all of the companies of New England to join in the movement to form an association of the gas light companies of New England. The circular having been ordered distributed at a conference held in Boston July 4, 1861, with the provision that its contents (the latter were prepared at the tentative meeting) thereof be revealed at a meeting to be held in Boston July 17. Meanwhile the petroleum spirit was greatly disturbing the gas makers, and the candle manufacturers as well. Indeed, petroleum, or coal oil, or rock oil as it was indifferently being noted, was attracting the attention of the world-at-large. In this connection it is entirely pertinent to note that the JOURNAL for September 2, 1861, contained a complete reprint of the ever since famous article from the pen of Prof. E. B. Andrews, of Marietta, Ohio, entitled "Rock Oil—Its Geological Relation and Distribution." This article originally appeared in Silliman's Journal, Second Quarter, 1861. A curious and most interesting table is to be found in the issue for November, 1861, which gives the details of the companies in the States which had credit from the Government of the United States. The totals of the tables show that in the 11 Confederate States there were 44 operating companies. Naturally the largest of these was the New Orleans Gas Light Company, with a capitalization of $1,500,000; the smallest was the Huntsville (Ala.) company, capitalized at $17,325. The total capitalization of the 44 amounted to $5,429,760. The totals for the entire States at the time were, respectively: Number of companies, 420; total capital, $51,620,940. It is worthy of note that towards the close of 1861 appears the first notices of describing "A Gas Furnace for General Chemical Use," the invention of Mr. John Jos. Griffin, F.C.S., England. The writer often heard the late Mr. J. J. Griffin of Philadelphia declare that the aforesaid Jno. Jos. Griffin was his paternal grand-uncle. In the beginning of 1862 (February) the average price of gas obtained by the 420 companies averaged $4.06 per 1,000; the minimum was $2.50, by the Brooklyn, New York and the Pittsburg, Pa., companies, respectively; the maximum by the Marysville (Cal.) company, at the figure of $12.50.

At its wits' end to raise funds for the defence of the Union, the Government (took the recommendations in September, 1862, of the Committee on Ways and Means of the House) decided that a tax of 25 cents per 1,000 cubic feet should be levied on the output of the companies. Then, as now, the proprietors of the JOURNAL, always on the lookout for the best interests of the trade, combined in an effort to grade the proposed tax on the basis of yearly output, and were very outspoken in the premises. In an abstract (March 15, 1862) among other things written on the topic it was said: "The gas companies of Albany, N. Y., Baltimore, Md., Boston, Mass., Brooklyn, N. Y., Buffalo, N. Y., New Haven, Conn., New

(*Continued on page* 298.)

GEORGE WARREN DRESSER

JOSEPH RUSSELL THOMAS



GEORGE A. MCILHENNY

WILLIAM HENRY WHITE

Four Men whose Work in Fraternizing the Gas Fraternity was of the Pioneer Type.

[Prepared by Mr. Arthur E. Boardman, Brevard, N. C.]

The semi-centennial of the founding of the American Gas Light Journal, is an event which brings to the minds of surviving veterans of the gas lighting industry many memories of struggles which have made progress possible, and of the comrades who have "fought the good fight," and passed to their reward.

Fifty years ago the gas business was in what might be termed a "feudal" state, where each undertaking was walled about with suspicion and by distrust of its neighbor, and surrounded by a deep moat of prejudice and self-complacency; where the drawbridge was constantly raised against the entrance of new ideas, and progress was resisted almost by force of arms; where the secret processes of each plant were jealously guarded, by watchful sentinels, against the prying eyes of the consumers and possible spies from kindred enterprises.

Contrast this with the open conduct of the gas works of today; where every visiting gas man is welcomed and every process for decreasing cost of manufacture, and for saving by-products is cheerfully explained; where numerous associations, national, sectional and State, are formed for the purpose of exchanging experiences, investigating new processes and mutually helping each other.

To what influences and to whose exertions are these great changes in so short a time due? To competition with other sources of artificial light? Only partly, for the change had already commenced, in fact, had progressed materially, before competition had really made itself felt. No; competition merely accelerated a movement already well underway. It was the influence of the American Gas Light Journal, the pioneer in this field, and of its followers; and the exertions of a number of far-sighted, enthusiastic men, who early saw the advantages of co-operation, and labored constantly and generously to bring about a period of "peace on earth and good will among (gas) men." Prominent among these were two, who, in succession, guided the policy of the American Gas Light Journal, and wrought constantly for its welfare and for that of the gas industry. These were Major George Warren Dresser and Colonel Joseph Russell Thomas.

Major George Warren Dresser.

Major Dresser was born September 15, 1837, in Abington, Conn., and was educated successively at the Worcester (Mass.) High School, the Andover (Mass.) Academy, and the West Point Military Academy, graduating from the latter in the class of 1861. In these institutions he laid the foundations, broad and deep, which enabled him to become an eminent and successful engineer, and imbibed the culture and social polish for which he was so distinguished.

Graduating, as he did, just upon the outbreak of the war between the States, he entered at once into active service, as Second Lieutenant of the Fourth United States Artillery on May 6, 1861. Except for the period from September, 1862, to August, 1863, when he was detailed as Assistant Instructor of Artillery Tactics at West Point, he was constantly in active service at the front throughout the war. As First Lieutenant, he took active part in the battle of Bull Run and the subsequent defense of the city of Washington. In 1862 he was assigned to engineer duty at the siege of Yorktown, and held the position of Active Ordnance Officer of the Third Army Corps. After serving at West Point as Instructor, he returned to the Fourth Artillery and was assigned to engineer duty and the command of his company at Chattanooga, Tenn. In July, 1864, he was appointed Inspector of the Fifth Army Comps. He was brevetted Captain, in August, 1864, for gallant services on the Weldon (Va.) Railroad, and made a regularly commissioned Major in March, 1865, in recognition of his gallant and meritorious services on the field during the war. He resigned, March 13, 1865, when the war was practically over, with the respect and affection of his comrades in arms.

An incident occurred while he was on duty near Chattanooga which will serve to illustrate Major Dresser's courage and engineering skill. It is told most graphically in his obituary, in the Journal under date of June 16, 1883, from which is quoted:

"The point at which the Chattanooga division was concentrated at this particular time, was situated some 86 miles from the base of supplies. The roads were very bad, and the surrounding country swarmed with detached bands of Confederate guerillas, who paid particular attention to the harassing and destruction of the trains destined to convey supplies to the Federal soldiers. The marauders had been very successful in their efforts to intercept the supply trains, and the Federal troops suffered much hardship in consequence. On the other end of the line, some nine miles distant, the Confederates were in possession of a river, on the south bank of which they had a strongly intrenched redoubt, garrisoned by a large force of picked men. General Grant, who had command of the Union forces at this point at that time decided that the only thing to do was to bridge the river, and, if possible drive the enemy from shelter. General W. F. Smith, well known as "Baldy," was summoned by General Grant and ordered to undertake the perilous task. General Smith selected the subject of this memoir to take charge and direct the operations of building the pontoon bridge, and to lead the assault. The young lieutenant, in the face of a most galling fire from the redoubt on the opposite side of the river, successfully built the bridge, and in the subsequent charge routed the Confederates, and the future supplies of the Federal Army were assured."

After leaving the Army, Major Dresser devoted himself to the practice of the profession of civil engineering, and was engaged successively upon the Government works in Narragansett Bay, the Block Island breakwater, and at Fort Adams, Newport, R. I. In 1869, he was Resident Engineer in charge of the Portchester Railroad, and in 1870 built the Wickford (R. I.) Railroad. From 1870 to 1873 he was Engineer-in-Charge of the extensive alterations made on the New York Croton aqueduct between 92d and 113th streets, under Mr. E. H. Tracy, the then Chief Engineer of the Croton Aqueduct Department.

In October, 1875, Major Dresser became Editor of the American Gas Light Journal, and continued in that capacity until his death, which occurred on May 27, 1883, at the Reitz Cottage, in Newport, R. I., after a long and agonizing illness, at the comparatively early age of 46 years. It was during his connection with the Journal that he became known to and loved by the members of the gas profession. From the first his pen was wielded in advocacy of mutual confidence and good will between gas managers, and he soon became a recognized leader in every movement conducive to helpfulness and co-operation among them.

In October, 1875, at its third annual convention, and shortly after he became Editor of the Journal, Major Dresser was elected an Honorary Member of the American Gas Light Association, and no man did more than he to build up the membership and increase the interest in and usefulness of that body. On December 1 of the same year the Society of Gas Lighting was formed, and Major Dresser was chosen its first Secretary, and continued in that office during the rest of his life. He was elected an active member of the American Society of Civil Engineers on July 5, 1876, and made a Director in the same in 1882.

Major Dresser twice visited Europe in the interest of the gas profession. The first time in 1878, as representative of the gas industry of the city of New York, to examine and report upon the progress of electric lighting there, and particularly upon the success of the Jablochkoff candle, which had just been introduced and extensively advertised. His report reflected his keen insight and business acumen, and encouraged many timid holders of gas stocks. His second visit was in 1881, in connection with the introduction of the "Ross" stoking machinery to the notice of European gas engineers. Then it was that he was elected an Honorary Member of the British Gas Institute, and the French Association of Gas Engineers. Our foreign brothers were quick to recognize his ability as an engineer and his high character as a man. And it is in his character of a noble Christian gentleman that his old comrades love to remember him. While he was always ready to help with his wise counsel and great engineering experience, it was the hearty handshake, the genial greeting to his friends, his unselfish devotion to the upbuilding of the associations with which he was connected, which endear his memory to us all, at this fiftieth anniversary of the Journal which he served so well.

Joseph Russell Thomas.

In the following month; that is, June, 1883, the editorial chair made vacant by the death of Major Dresser, was filled by the sturdy form of Mr. Joseph Russell Thomas, who for nearly 30 years had guided the destinies of the Williamsburg Gas Company, Brooklyn, N. Y., as its Engineer and Superintendent.

Mr. Thomas brought to this new field, the experience of a lifetime in the construction and management of gas works, for it has been well and truthfully said of him that there was nothing about such a plant which he did not understand and could not plan and execute, from the foundations of the retort benches to the crown sheet of the holder; and that he could manage and operate it, when completed, as well as the best in the gas fraternity.

Without advantages of early schooling and training in mathematics and engineering, he won his way by force of character and untiring perseverance to the front rank in his profession, self-taught and self-made in the best sense of the word.

Born March 11, 1820, in Burlington, N. J., where his father, Mr. W. R. Thomas, originally from Wales, was temporarily sojourning, he was taken as an infant to Philahelphia, where his childhood and early manhood were passed. There he attended the public schools and imbibed from his father, who was a manufacturer of pressed brick, for which Philadelphia is renowned, practical knowledge in certain mechanical lines. This knowledge was further developed and strengthened by apprenticeship to a prominent carpenter and builder in Philadelphia. Thus he early became skilled in the use of tools, and learned the value of accuracy in construction and also became conversant with plans and drawings.

His first venture for himself, however, was in the grocery business, which, being foreign to his mechanical genius and natural bent, he soon abandoned.

About this time the Camden (N. J.) Iron Works, founded by the Messrs. Starr, of Philadelphia, became more and more engaged in the manufacture of gas works machinery, under the direct supervision of Mr. Samuel A. Thomas, an elder brother of Mr. Joseph R. Thomas. Mr. John W. Starr, a member of the Camden Iron Works Company, about the year 1845, took a special contract to do certain work on some vessel for the Messrs. Stevens, at Hoboken, N. J., and prevailed upon Mr. Thomas to give up mercantile life and assist him in this contract. He, therefore, moved to Hoboken, to take charge of this work. When it was completed he remained with the Messrs. Stevens, and worked for them on the "Stevens Battery," renowned of old in Hoboken.

In 1848 Mr. Thomas removed to Camden, N. J., and entered the employ of the Camden Iron Works, where he soon was placed in charge of the construction of the gas contract work of that company. During his connection with it he had charge of the construction of the 21st and 22d street station of the New York Gas Light Co., the works of the Gas Light Company of the City of New Brunswick, N. J., and those of the City Gas Light Co., of Norfolk, Va.

Internal dissensions in the Camden Iron Works Company, in which Mr. Thomas did not care to take sides, caused him to resign his connection therewith about 1851. After this he reconstructed the Detroit (Mich.) gas works under a contract which was so satisfactorily carried out that he was paid at its completion, as a bonus, a considerable sum above the contract price. Returning East he was soon engaged by Mr. John W. Starr, between whom and himself there existed a strong bond of association and affection, to take charge of the Williamsburg (N. Y.) Gas Works, as its Engineer and Superintendent, which he did in January, 1854. To this work he devoted his great energy and ability until the spring of 1883, when the control of the stock of that company was acquired by the Standard Oil interests, with the policy of which Mr. Thomas had no sympathy. It was a strange coincidence that the same issue of the AMERICAN GAS LIGHT JOURNAL in which appeared the obituary to Major Dresser, contained a brief item headed "Gobbled by the Standard," recounting the election of William Rockefeller et al. to the directory of the Williamsburg Gas Company. It was also characteristic of the man that, when requested by the new management to act as Chief Engineer of their gas properties in Brooklyn, Mr. Thomas replied that no sum could induce him to ally himself with any interest in a company whose policy he could not sympathize with, and insisted upon the acceptance of his resignation, already tendered.

For years Mr. Thomas had been active in the upbuilding of the various associations of gas managers, and had co-operated therein with Major Dresser. So the policy of the JOURNAL in this respect remained unchanged, and its influence continued to be exercised in behalf of unity and mutual helpfulness among those interested in the gas business. He was elected President of the Society of Gas Lighting at the date of its formation, December, 1875, and retained that office until his death. In February, 1878, he was elected an Honorary Member of the New England Association of Gas Engineers, and in 1881 became a member of the American Society of Civil Engineers. In 1883 he was made an Active Member of the American Gas Light Association; in 1884 he was elected an Honorary Member of the Western Gas Association; and in 1886, an Honorary Member of the Ohio Gas Light Association. He was also an Honorary Member of the Guild of Gas Managers. In all of these bodies he took a lively and an active interest, giving to each and all generously of his time and of his talents. Seldom was he absent from their meetings when his health permitted, and even when too ill to attend, he would always welcome those who had been present and brought him word of the events and discussions there. Many a time has the writer seen his rugged and kindly face light up with interest when told of some earnest debate between the advocates of rival systems, and his eyes twinkle with pleasure at the relation of some merry jest which occurred at such meetings.

After an illness of several months' duration, Mr. Thomas passed away, the evening of Saturday, Nov. 28, 1896, at the ripe age of 76 years. His widow and a daughter survived him. His was a long and useful life, for, besides his devotion to the gas profession, he was a trustee of the Dime Savings Bank of Williamsburg, an active supporter of the Public Dispensary, and of the Public Library Association of Williamsburg, and a liberal patron of the Brooklyn Art Association. He attained high honors in Masonry and was for many years a vestryman of Christ Episcopal Church on Bedford avenue, Brooklyn.

In person and in character he was large, strong and aggressive. Positive in his opinions, his world was divided absolutely between friend and foe; there was no middle ground. To his foes he dealth trenchant blows, and gave no quarter; to his friends—and they were in the majority—his big heart went out generously, and nothing he could do or say was too good for them. And his friends stood as loyally by him; for often they would say, "I'm with Colonel Thomas, right or wrong." And they were safe in that, for he was generally right. He was a power for good in his day and generation, and his impress will be lasting upon the JOURNAL he so ably edited, and upon the Associations in which he was so prominent.

As our thoughts travel back over the years that are gone, many friendly faces rise to greet us in memory's treasure house. Among those who have added largely to our store of knowledge in the profession and have contributed most to our pleasure in the social intercourse of our associations, two names stand forth pre-eminent in the mind of the writer: George A. McIlhenny and William Henry White. Although not connected with either the business or editorial staffs of the AMERICAN GAS LIGHT JOURNAL their names may frequently be found in its columns, and they were among the best exponents of that which the JOURNAL has always advocated, generous contributors to the knowledge and good will of the members of the gas profession.

GEORGE A. MCILHENNY.

Mr. McIlhenny was born April 22, 1835, in Milford county, Donegal, Ireland, and came to America with his widowed mother in 1844, when nine years of age. He had two brothers, both well known in the gas business, Messrs. John and Oliver McIlhenny, and one sister, Mrs. Barr, of Washington, D. C.

His education was of brief duration, as far as schooling went, and was acquired in the Northwest Public School of Philadelphia; but his real education was continued by himself in the shops of the Baldwin Locomotive Works, and later in the Southwark Foundry. In these he became a master machinist, and laid the foundation for his success as an inventor in mechanical appliances which made him so useful to the gas profession. At the Southwark Foundry he also formed lasting friendship with its then manager, the late Mr. B. H. Bartol, who afterward became President of the Washington (D. C.) Gas Light Company, and who was instrumental in securing Mr. McIlhenny's services as Superintendent and Engineer for that company.

In 1857 he left the Southwark Foundry to accept a position with the gas works building firm of Messrs. Perdicaris & Hoy, and for them superintended the remodeling of the Charlottesville (Va.) Gas Works. From there he went to Macon, Ga., in the interest of the same firm, to remodel the gas works at that place. These works were originally designed for the manufacture of resin gas, and had been for about four years struggling with that fickle material. Mr. McIlhenny, then barely 22 years of age, promptly threw out the resin gas machinery and practically rebuilt the works to manufacture gas from the rich pine wood of the South, under the Cresson patents. He was so thorough and energetic in his work, and the new process proved so successful, that the management prevailed upon him to accept the position of Superintendent and General Manager, and from that moment prosperity accompanied the undertaking.

It was at this time and place that the writer, then a mere lad, first met Mr. McIlhenny, and began a firm and lasting friendship, which strengthened as the years went by and continued until he passed away on the afternoon of Sunday, October 16, 1892.

While in Macon, he was prominent in the social life of the place, and energetic in all useful pursuits. Among the organizations with which he allied himself was the Volunteer Fire Department, and he was always one of the first to respond to alarms. On one occasion, when repairs were being made to the engine house of the company to which he belonged, an alarm came in during the night, and, as frequently happened, Mr. McIlhenny was first to reach the engine. In striving to start it forward a heavy beam supporting some staging fell upon him and pinned him to the floor, where he lay prone until released by his later arriving comrades. Although no ill effects, beyond some bruises, were then apparent, he always attributed to this accident the cause and beginning of the locomotor ataxia, from which he so terribly suffered in after years.

Mr. McIlhenny remained in charge of the Macon Gas Works until the autumn of 1864, although his sympathies were with the Northern cause. Finally, when the Confederacy called every able-bodied man to arms between the ages of 16 and 60, his choice had to be made, and he decided to leave. With the full knowledge and assistance of the President and the Treasurer of the Gas Company, who respected his principles, he, with two companions similarly situated in regard to their sentiments, proceeded to Savannah, and after many hardships and narrow escapes, finally succeeded in "running the blockade" and reaching the Federal lines. Although the opportunity was presented, he consistently refused to take arms against the South, where he had made so many friends, and in March, 1865, he was called to Washington, D. C., by his old-time friend, Mr. Bartol, and accepted, under his Presidency, the position of Engineer of the Washington Gas Company.

Here began the great work of his life; and to it he devoted his splendid intellect, his untiring energy and his indomitable will. Soon the Washington works became one of the foremost in the country in the use of new appliances, in economy of manufacture and in progressive management. His inventive genius gave to his company, and then to the gas world, one of the first self-sealing retort lids, a very successful regenerative furnace for retort benches, the vacuum process for reducing the deposit of carbon in retorts and stand-pipes, and a number of other appliances of great value. Nor were his tremendous energies confined to the gas lighting field, for in street railway work he was a powerful factor, and in banking he rose to the Presidency of the West End Bank, while always he was a power for good in the Presbyterian Church, with which he very early became affiliated.

The devotion to duty and rare fortitude of the man were made manifest when, after the disease from which he suffered had progressed so far as to deprive him of the ability to walk and scarcely to stand without assistance, still he was daily carried to his carriage, driven to the gas works, and there wheeled about in a rolling chair to inspect and direct the work of his men. And this continued, not for weeks and months only, but for 12 long years.

Besides the direction of the manufacture and distribution of gas, the erection of larger works and supervision of the general policy of the company, there were other duties which devolved upon him. There were demagogues in Congress then, as now, politicians who cared not for the rights of property, nor who should be damaged by those who have, so long as they might pose as benefactors to those who have not, and thus "hold their jobs." Consequently, hardly a long session of Congress went by but that Mr. McIlhenny was called before some committee to show cause why a charter should not be given to some other company promising to supply cheaper gas, or why the then low price of that furnished by his company should not be further reduced. Then would he be wheeled into the committee room, and with painstaking patience and consummate diplomacy and tact would he spend hours in explaining the situation, and teaching his hearers lessons in true economy. And his knowledge of every detail of the business was so profound, his arguments so powerful and his logic so convincing, that no competing company found foothold, and never was the price of gas reduced unless his company could afford to do so, but always then, without pressure from Congress.

His faith in the future of the gas industry was profound and his words prophetic, for when the writer had occasion, in 1882, to rebuild the Macon gas works on a new location, and as a coal gas plant, Mr. McIlhenny counselled that it be built, not for a future growth of 10 or 15 years, but for one of 25, and, if the funds would permit, for 50 years. And that at a time when electric lighting threatened to destroy the gas business.

Mr. McIlhenny was one of the organizers of the American Gas Light Association, in 1873, and was at that time elected one of the Executive Committee. From 1874 to 1878, he served on its Finance Committee, and in 1879 was elected Vice-President; but his illness, which in 1880 became very pronounced, caused him to retire at the end of that term. In 1884 the Association held its twelfth annual convention in Washington in his honor, and as an especial mark of its regard and love for him. In 1887 he was elected an Honorary Member by both the New England and the Western Gas Associations. In 1883, after the death of Mr. Bartol, he was made President-Engineer of the Washington Gas Light Company, which position he ably filled to the time of his death. In that sad event the gas profession lost one of its most brilliant and kindly members, and many of us a loved and honored friend.

Captain William Henry White.

Of Captain White, what pen can do justice? That gallant soldier, that capable engineer, that polished gentleman, that prince of good fellows! He was with us so short a time ago that we can scarcely realize we shall see him no more. It is at our meetings and conventions where his absence is most noted by the gas profession at large, it is in the daily intercourse, which his genial presence brightened for his friends that he is most missed by those intimate with him.

Captain "Harry" White, as his friends always called him, was born in Philadelphia, March 4, 1843, and died of pneumonia at his home, the Hotel Marie Antoinette, New York City, July 3, 1904, in the 62d year of his age. He had just returned from attending a meeting of the Western Gas Association held in St. Louis, the latter part of June, and soon after the opening of the World's Fair, held in that city, when he was attacked by the disease which soon carried him off. He was feeling far from well while in St. Louis, and was obliged to relinquish a contemplated business trip to his water works at Selma, Ala. This trip the writer undertook for him, and it was while there that we received the sad news of his death.

Captain White's father, Colonel Ambrose J. White, was well and favorably known in the gas profession; one of the original members of the American Gas Light Association, and one of that coterie of gas engineers who built many works under Messrs. Perdicaris and Hoy, and included such well known men as Messrs. John and George A. McIlhenny, William Helme, and John P. Kennedy. Captain White often laughingly repeated a remark of his father to the effect, "That while he had produced many gas works, his most finished product in that line was his son Harry."

Soon after the outbreak of the Civil War, when less than 20 years of age, he enlisted as a private soldier in Company G, 68th Pennsylvania Volunteers. His command was attached to the Army of the Potomac, and with it he took part in the battles of Antietam, Fredericksburg, Chancellorsville and Gettysburg, and the engagements in the Wilderness. In August, 1863, he was promoted Sergeant-Major, and received his commission as First Lieutenant. He served until the end of the war and was mustered out at Hart's Island, N. Y., in June, 1865. His commision and title of Captain were derived from the Old Guard, one company of which he commanded.

Captain White was a 33d Degree Mason, and prominent in the club life of New York City. His chief devotion in this line was to the Lotos Club, of which he was Vice-President for many years, declining time and again to compete for the Presidency against his friend, Mr. Frank R. Lawrence.

Captain White's experience in gas engineering was extensive and varied. After leaving the army, he entered the gas business under his father, who was then Engineer for the Metropolitan Gas Company, of New York City. The following year he was made Engineer of the Memphis (Tenn.) Gas Company, where he remained some time. He was next placed in charge of the Elizabeth, N. J., gas works, and in 1870 was appointed Engineer of the People's Gas Company, of Brooklyn, N. Y. In 1872, he was made Engineer of the Citizens' Gas Light Company, also of Brooklyn. In 1878 he was the New York agent of the Goodwin Gas Stove and Meter Company, and from 1881 to 1883, Constructing Engineer of the Equitable Gas Company, of Baltimore, Md. After that he engaged in the business of consulting and constructing Engineer in gas, water and electric works, and many plants throughout the country received the benefit of his skill and genius. His services as expert in his profession were frequently sought to aid in extricating gas and water works from physical and political difficulties, in which he was most successful.

Although so highly gifted as an Engineer, and so well versed in his profession, it was as leader and organizer of the social life of his comrades in the various gas associations wherein he was

best known and most valued. His friends often remonstrated with him against sacrificing his undoubted professional leadership for that of "King of the Carnival," as it were; but he always answered that there were a number of others in the Associations as well fitted as he to do the serious work, but he felt there was none other with his talent for entertaining who was willing to devote his time to that necessary branch of association work. And he was right, there was no one who could do so, as well, however willing.

His fellow engineers appreciated his worth, for he was, at the time of his death a past-President of the American Gas Light Association, Secretary of the Society of Gas Lighting, and an Honorary Member of the New England Association of Gas Engineers and of the Western Gas Association.

His immediate popularity with "all sorts and conditions of men" with whom he came in contact, is illustrated by an incident at Selma, Ala., where he built the water works and held the position of President-Engineer of the Company. On this occasion there had been some misunderstanding between the local management and the City Council, and Captain White was summoned from New York to "straighten things out." After he had accomplished it, in his usual happy manner, there was a "love feast" at which both parties to the controversy and invited guests were present. At the end of the feast the Mayor arose and proposed Captain White for membership in the local Post of Confederate Veterans, and he was there and then elected by unanimous acclamation.

On another occasion the City Council of Macon, Ga., wished to acquire the water works, and Captain White was called upon to assist in placing a valuation upon the plant. The arbitration committee had been at work a number of days, and had not quite finished its labors, when, at a regular meeting of the City Council, after some discussion as to probable outcome, Alderman O'Connell arose, and in the richest of brogues, which cannot be reproduced in print, said: "Your Honor, the committee of arbitration has not yet finished its work, and we don't know how much we'll have to pay for the water works. One thing, however, we do know is that the city can issue only $500,000 of bonds. Now, what do we want to buy the waterworks for, anyway? They are here and can't get away, so we have them already. Therefore, I move, and I hope for a second to the motion, that we issue the whole $500,000 in bonds and give the bunch to this man Captain White, if he'll come and live here, for Macon hasn't seen so much fun in 20 years as it has since he came among us."

Alderman Bond, who was an undertaker and furniture dealer, in seconding the motion, said he hoped the motion would carry, and if the Captain accepted the proposition he would promise him a glass front, silver-mounted, "oviel top," casket to bury him in. Amid the laughter which ensued it could never be decided whether or not the motion prevailed.

Captain White was as generous as he was genial, as sincere as he was sympathetic, and to many an unfortunate comrade has he given substantial aid. Only those who received it know of his bounty, for he was not one to parade his good deeds.

In closing this inadequate sketch no more appropriate words can be said than were used by the Society of Gas Lighting in its obituary minutes, as follows:

"It is no easy task to find words to adequately express the sense of loss to our profession, or the feeling of personal loss to each and every one of us. We who were privileged to be intimately connected with him, meeting him frequently socially as well as in business relations, knew him as he was, and not only as the genial, cheerful and always pleasant companion, but as a man, ever ready and willing to aid his fellows with sound advice, and to freely impart all the knowledge and experience that he had gained during his long and varied career as an engineer. Many of our young engineers will long hold his memory in grateful remembrance for helpful counsel given in time of need.

"He was generous to a fault, both heart and purse, always responding to appeals from those who were unfortunate, requiring substantial assistance.

"Erect in stature, of pleasing appearance, endowed with a strong individuality, he was always sought for to assist at our public as well as private meetings and entertainments. We have all many times listened to the easy flow of rhetoric with which he was wont to address us; never wearisome, always enjoyable, and always appropriate, whatever might be the occasion. It may be safely said that it will be long before his place in the profession can be filled; his place in the hearts and affections of his intimate friends never can be."

Gas Association Work and Its Influence in and on the Gas Industry for the Last Half Century.

[Prepared by Mr. George G. Ramsdell.]

The history of the gas associations of the United States during the past fifty years is so interwoven with the history of the American Gas Light Journal and of some, if not most, of the gas engineers of the country, that to recite the history of either must of necessity include the others to secure a complete retrospect; and it would be equally impossible to measure the vast influence exerted except in a more or less combined form.

Each entered an undeveloped field—each performed its important part; and we can only see and appreciate combined results. Yet I am of the opinion that by far the greatest results apparent have come from the associations.

Those of us who are old enough and were fortunate enough to have assisted in the formation of either of the older associations can but realize the extremely modest and unassuming nucleus which some pioneer with faith in the future to inspire his persistent efforts had produced, resulting in a meeting to decide whether "To be or not to be," a seemingly unimportant matter then, but now we realize a most important one, to the entire gas fraternity. In fact from the time of the first association, changes began which have led to the amazing results, to which we are now so accustomed that we scarcely realize how very different were the conditions then.

Instead of the secrecy which then enveloped our entire business and seriously retarded progress, a fraternal exchange of opinions and results has continuously grown and enlarged to the advancement of the art.

It is also readily apparent that, while the influence of the associations have caused great changes in the conduct of the business, the associations themselves have undergone equally remarkable changes. In the early days technical gas engineers were comparatively unknown, while to-day the membership is very largely of this class. As a result the character of the meetings is of a much higher standard, and therefore of increased value. Mutual advantages accrued to the business itself, to the men who made up the associations, and even to intimately associated interests.

In the chronological history of gas lighting, Baltimore has the honor of its adoption, in 1817, but it made very little advance until about 1830, when it began to be adopted in other places, and slowly advanced for some years, growing more stable and permanent in character as its advantages became increasingly apparent, until, in 1859, its importance was sufficient to justify the advent of its first trade paper, whose fiftieth year we are now celebrating; and it was 12 years later, or in 1871, before the first gas association, the New England Association of Gas Engineers, was brought into existence.

While this proved to be a lusty infant, I doubt if any of its progenitors in their wildest fancy anticipated the time would ever come when one of its chief virtues—proclaimed in post-prandial eloquence—would be that in the natural course of events it had become the "Mother of Gas Associations."

In trying to gather information of the formation or very early history of this Association, I accumulated quite a little material, much of which proved to be of a legendary character, and I finally took the history as published in the American Gas Light Journal as the most reliable data available; and it is particularly appropriate, as it displays the fact that to some extent the Association was the result of the influence of the named paper.

The editorial in the current issue reads as follows:

"We have from time to time urged the great necessity of an Association of Gas Engineers, the object of such organization being to learn from each other's experience the best and most economical processes for making gas, for the protection of those engaged in its manufacture, and also as a means of social and intellectual intercourse among our gas managers throughout the United States.

"Although our efforts met with considerable favor and much correspondence followed, which was published in the Journal, giving the ideas and suggestions of various parties, still the point aimed at—a convention—failed. We are happy to announce, however, that the New England Gas Engineers have made the proper movement."

Before quoting further from the editorial, it seems desirable to state that, in the latter part of the year 1870, there were three serious gas explosions, which occurred at nearly the same time. One at Cincinnati, one at Baltimore, and one at Worcester, Mass. The latter explosion, which occurred Friday, Dec. 16, 1870, assumed greater prominence from the fact that the Hon. James

Barnard Blake, the Superintendent of the Gas Company, and also the Mayor of the City of Worcester, and a very popular man, was unfortunately killed, dying on the following Sunday, Dec. 18, from injuries caused by the explosion.

This series of explosions undoubtedly quickened the desire of the gas fraternity for some speedier and more effectual way of consultation to devise means of preventing the recurrence of such accidents. In fact, it was while in attendance at the funeral of Mr. Blake that the first steps were taken, as the editorial records:

"At the funeral of the late lamented James B. Blake, Mayor of Worcester, who died from the effects of the late explosion in that city, seventeen gas companies were represented, and preliminary steps were taken to form an association, to be called the New England Association of Gas Engineers. Pursuant to the above a meeting was held in Boston, Thursday, February 2 (1871) and the organization was completed with the following board of officers:

President .....W. W. Greenough, Boston
Vice-President.....Geo. Dwight, Springfield
Vice-President.....Wm. Yorke, Portland
Secretary and Treasurer.....Geo. B. Neal, Charlestown

My understanding is that the results obtained were largely the result of the personal efforts of Geo. Dwight, who is generally credited the prime mover in the matter.

You will note that, although the Association was called an association of engineers, it was really an association of gas companies.

The success of the New England Association immediately impressed itself upon the fraternity at large and created a desire for a similar organization in a less remote center, and undoubtedly resulted in a movement that has steadily grown in volume, membership, importance and results.

In the following year, 1872, Mr. Peter E. DeMill, of Detroit, Mich., one of the active men in the profession, started a movement in which he was ably assisted by Mr. William H. Price, of Cleveland, and Geo. Dwight, fresh from the organizing of the New England, which resulted in a conference in September, of that year, when steps were taken and a call issued for a meeting which was held in New York, April 16, 1873, when an association was formed and called The Gas Light Association of the United States, and, following the example of the New England, was composed of gas companies, only to be changed later, the name to "The American Gas Light Association" and the membership to individuals, a change which proved beneficial. Its first officers elected at that meeting were:

President .....Gen. Charles Roome, New York
First Vice-President.....Peter E. DeMill, Detroit
Second Vice-President.....Wm. H. Price, Cleveland
Third Vice-President.....Thos. R. Brown, Pennsylvania
Secretary.....Prof. Henry Wurtz, New York
Treasurer.....J. W. Smith, New York

The first years of this Association developed many discouragements, owing to the limited income from a small membership, and a large measure of credit is due the American Gas Light Journal for its valuable assistance and encouragement freely given at this critical period. At its own expense stenographic reports were taken of the meetings, and the published proceedings which were liberally distributed attracted the attention of the gas fraternity (by unpurchasable advertising) that, linked with editorial comment, undoubtedly did much to build up the membership and interest in the work, which rapidly overcame financial difficulties.

A rather interesting feature of the proceedings of this first meeting, establishing a precedent that could well be followed, is given as follows: "The following gentlemen, distinguished in different specialties, were invited by the Executive Committee to deliver discourses, or lectures, at the first annual meeting in October, on such subjects as they may severally select:

Mr. Geo. McIlhenny.....Washington, D. C.
Dr. J. Lawrence Smith .....Louisville, Ky.
Mr. James R. Smedberg.....San Francisco, Cal.
Mr. Williams .....Philadelphia
Prof. Henry Wurtz.....Editor American Gas Light Journal

These combined movements led to the formation of the Society of Gas Lighting, of New York, which was organized in 1874 very largely through the efforts of Col. Geo. H. Armington, and whose first officers were as follows:

President.....Col. Joseph R. Thomas
Vice-President.....Mr. Geo. W. Edge
Secretary.....Mr. G. W. Dresser
Treasurer.....Col. Jas. H. Armington

This Society was, however, almost entirely local in membership, and while it has contributed much of a technical character, yet it has always been largely a social organization. Probably its most important work that exerted an influence on the fraternity at large was the published report of its Committee (A. H. Strecker, Eugene Vanderpool, A. B. Slater and D. D. Flemming), whose report was adopted by the Society January 21, 1892, on the Standardizing of Cast Iron Pipe and Specials, a work that has in recent years been again taken up and remodeled to meet the changes that time made necessary.

I think it is proper at this point to note the fact that, in 1876, Major G. W. Dresser became the Editor of the American Gas Light Journal, and who in the few brief years before his death probably did more to advance the Gas Associations than any one before him. Having at his command the columns of the Journal, and being thoroughly impressed with the importance of association work, he entered into that work with remarkable energy and became an inspiration that left a lasting impress on the movement.

The Western Gas Association, in response to a call issued by J. O. King, of Jacksonville, Ill., was formed at a meeting held in St. Louis, September 18, 1878, and the following officers elected:

President .....J. O. King, Jacksonville, Ill.
First Vice-President.....J. C. Zabriskie, St. Louis, Mo.
Second Vice-President.....Wm. Wallace, Lafayette, Ind.
Secretary and Treasurer.....L. A. Hall, Louisiana, Mo.

Representatives were present from 23 gas companies, and from a very modest beginning it became largely national in character and membership, and a most important factor in association work.

It never lost its distinctively Western characteristics, and its meetings were noted for Western hospitality and for a freedom in discussion that was somewhat absent in the larger body of the American, making its meetings in some respects very popular and interesting. It was still in a very vigorous and healthy state when its career closed with its merging into the American Gas Institute.

The Guild of Gas Managers, of New England, was formed in March, 1881, and, like the Society of Gas Lighting in New York, has always maintained a social character, filling much the same sphere in the city of Boston. Its officers were:

President.....Geo. D. Cabot
Secretary .....A. B. Slater
Treasurer .....John Andrews

The Ohio Gas Light Association was formed as a State association in 1884, and although a State organization, was so well officered, and so enterprising in its general work, that it speedily outgrew its limited field and rapidly enrolled a membership that was more national than State in character. In fact, the rapid strides made by this Association soon embraced a membership placing it on an equal footing with either the American or the Western.

The gas fraternity now had three vigorous, healthy associations, covering much the same territory, each of which held annual meetings of such value that they possessed a drawing power that was difficult to resist, and as the members as a rule were largely members of the three associations, the attendance at so many meetings in each year began to prove burdensome. For several years there had been growing in the minds of some of the more observant members of the various associations a desire to largely improve conditions and overcome some of the inherent weaknesses existing in the associations and at the same time if possible to concentrate the work.

Several papers had been presented, bearing on the subject, noticeably the one by Mr. Walter R. Addicks, on "Federation," in 1892, which, with others of similar character, coupled with the discussions, while most excellent, were probably in advance of the times; but the rapid strides of the Ohio Association, mentioned above, accentuated matters, so that ideas which at the time seemed impracticable were ripening and which took shape at the World's Gas Congress, held at St. Louis, in 1904, of which I will speak later.

In July, 1893, the Pacific Coast Gas Association was formed, largely through the efforts of Mr. Jos. B. Crockett and Mr. Edward C. Jones, both of whom had been active in the Eastern Gas Associations, but who felt the need of a similar organization on the Coast in order to secure the valuable benefits enjoyed by the fraternity east of the Rockies. At that meeting there were present 54 gas men, who enrolled as charter members and organized with the following officers:

President.....Jos. B. Crockett
Vice-President.....J. L. Hallett
Secretary and Treasurer.....John A. Britton

An incident of the meeting was the presentation by Mr. John Martin to each member of a gold badge in the form of the seal adopted by the Association, a seal representing perfect circulation—no dead ends—designed by Mr. E. C. Jones from a form made by his father, who was a pioneer in the gas industry.

One of the most important events in gas history in this country occurred in June, 1904, when the "Congress of Gas Associations of America" was held in St. Louis, in conjunction with the World's Fair. Mr. F. H. Shelton, then President of the Western Gas Association, started a movement which resulted in the appointment of a committee to report on the practicability of a joint meeting of all the Associations in a Gas Congress. This committee found the sentiment such that it made a favorable report, and the meeting was called to meet June 15 and 16, 1904.

This meeting was very generally attended, 10 Associations being represented by an attendance of nearly 300. The presiding officers were the Presidents of five of these Associations: Rollin Norris, of the American; F. H. Shelton, of the Western; F. W. Stone, of the Ohio; W. A. Aldrich, of the Pacific, and E. G. Pratt, of the Wisconsin.

The papers read were of unusual interest, but the paper that contributed most to the subsequent outcome was the paper by Mr. Henry L. Doherty, on "Gas Association Work," in the discussion of which the long-deferred movement of consolidating or merging the Associations began to take form.

It was a somewhat surprising fact that the first vote taken, that could be classed as a test vote, disclosed a unanimous desire for such a change, all subsequent votes were also unanimous, and it is not too much to say that most, if not all, of the steps taken were of the spontaneous character. It was evident that there was a genuine depth of feeling that some such step should be taken.

The discussion culminated in a resolution that a committee of two be appointed by each Association in the country, and that this committee "appoint three delegates at large (forming a committee of 23 in all), who were instructed to prepare a plan for the merging of the three Associations," the American, the Ohio and the Western, these Associations, upon the merger going into effect, to pass out of existence.

This committee was made up as follows:

American.....Wm. McDonald, F. H. Shelton
Guild.....Wm. A. Wood, Chas. F. Prichard
Kansas.....Samuel Scovil, J. A. Bendure
Michigan.....H. W. Douglas, B. C. Cobb
New England.....C. D. Lamson, N. W. Gifford
Ohio.....John D. McIlhenny, B. W. Perkins
Pacific.....E. C. Jones, John A. Britton
Society Gas Lighting.....C. J. R. Humphreys, Geo. G. Ramsdell
Western.....Donald McDonald, Paul Doty
Wisconsin.....H. H. Hyde, E. G. Cowdery
At large.....W. R. Addicks, Walton Clark and H. L. Doherty

It can be readily understood that the work assigned to this committee was as difficult as it was important, and great credit is due for the very able way in which the work was performed. The various steps were taken and the merger fully accomplished when the American Gas Institute held its first annual meeting, Chicago, October, 1906, its first officers being:

President.....B. W. Perkins
Secretary.....James W. Dunbar

All Associations were invited to participate, whether they became members or not, and it was understood that the matters of Associations other than the three named becoming members, either as actual members or auxiliary bodies, was to be left for future action, it being considered that if the three largest Associations would disband their own organizations to form the new and larger one, it was all that could then be taken up.

This committee proved a very wise and well-selected one, entered promptly upon its duties, and in October, 1906, had advanced far enough to see its plan adopted. The American Gas Institute formed, and the same time witnessed the dissolving of the American, the Ohio, and the Western associations.

The Michigan Gas Association was organized in 1893, in response to a call issued by Messrs. H. D. Walbridge and H. W. Douglas, the meeting being held in Kalamazoo, with Mr. Sedgwick as President.

This Association, in 1900, established a fellowship at the University of Michigan, providing $500 for the expense of a student to take a post-graduate year on subjects of particular interest to the gas fraternity. Nine students have availed themselves of this fellowship, taking up the following subjects: "Relation of Heating and Illuminating Value of Gases, Especially as Applied to Incandescent Mantles"; "The Theory of the Incandescent Mantle"; "Loss of Illuminating Power of Mantles while Burning"; "Naphthalene"; "Studies in the Manufacture of Coal Gas" (three successive years); "Coal Distillation" (two years).

The Texas Gas and Electric Light Association was formed in 1895, this being the first to introduce the combination of gas and electric light.

The International Acetylene Association was organized in July, 1898, with the following as its first officers:

President.....George Landis Wilson, Chicago
Secretary.....J. B. Carroll, Chicago
Treasurer.....C. D. Moody, Louisville, Ky.

The Kansas Gas, Water, Electric Light and Street Railway Association was organized in September, 1898, with the following officers:

President.....L. F. Palmer, Leavenworth
Vice-President.....E. S. Wills, Atchison
Secretary.....J. H. Foley, Leavenworth

The Wisconsin Gas Association was another of the State Associations formed in 1902, which has been very active and valuable.

The Southwestern Electric and Gas Association was formed April 27, 1904.

The Empire State Gas and Electric Association was organized in February, 1905, with the following as its first officers:

President.....W. W. Cole
Vice-President.....T. M. R. Meikleham
Secretary and Treasurer.....T. R. Beal

The Illinois Gas Association was organized April 19, 1905, with the following officers:

President.....George F. Goddnow
Vice-President.....Z. T. F. Runner
Secretary and Treasurer.....E. E. Morrell

As its name implies, it is a State Association, but its central location and its western flavor bid fair to make it of greater importance than the ordinary State organization.

The Iowa Gas Association was organized in May, 1905, with the following officers:

President.....L. L. Kellogg
Vice-President.....Geo. McLean
Second Vice-President.....Jansen Haines
Secretary and Treasurer.....F. W. Kelly

The National Commercial Gas Association held its first meeting May 12, 1905, and issued a call for a meeting June 12, when a permanent organization was effected and the following officers elected:

President.....Wm. J. Clark
First Vice-President.....Chas. E. Learned
Second Vice-President.....F. W. Freuauff
Third Vice-President.....J. D. Shattuck
Secretary-Treasurer.....Lucius S. Bigelow

This Association virtually opened a new field, and was formed in the interest of that large class of gas men who had in charge the appliance department of gas companies. One of the principal features of the Association is its annual exhibition of appliances, its first being held in the Knickerbocker Building, New York City,

January, 1907; the second in the First Regiment Armory, Chicago, December, 1908, and the third exhibition will be held in Madison Square Garden, New York City, December, 1909.

This Association is undoubtedly doing a good work, and while it has been somewhat difficult to eliminate the intrusion of advertising in its meetings, yet limitations are being drawn that will greatly improve this very important feature.

The Illuminating Engineering Society was organized January 10, 1906, with the following officers:

President.....L. B. Marks
First Vice-President.....Dr. C. H. Sharp
Second Vice-President.....A. A. Pope
Secretary.....V. R. Lansingh
Treasurer.....Dr. A. H. Elliott

As its name suggests, illumination embodies all systems of lighting, and it has gathered into its membership a remarkably large body of men, and while electric interests largely predominate, it contains the names of many gas engineers as well as architects and those of kindred occupations.

The parent body is located in New York with sections in Boston, Philadelphia, Chicago and other cities. This Society opened up a new field and brought into prominence a branch of the lighting art that should not have been so thoroughly neglected by the older associations. Its rapid growth and the interest taken in its meetings show convincingly that the subject needed only to be taken up to awaken a prompt response. Its meetings, while very interesting, have contained rather more "shop talk" than is appropriate for a technical society; but I believe this is gradually improving.

The Natural Gas Association of America was organized March 20, 1906, with the following as its first officers:

President.....K. M. Mitchell
Vice-President.....M. M. Sweetman
Treasurer.....C. H. Pattison
Secretary.....J. H. Dunkel

The Indiana Gas Association was organized as a State Association February 10, 1908, with the following officers:

President.....James W. Dunbar
Vice-President.....W. B. McDonald
Secretary and Treasurer.....Frank K. Lane

The Southern Gas Association was organized at Atlanta, Ga., May 18, 1908, with the following officers:

President.....T. D. Miller, New Orleans
Vice-President.....R. C. Congdon, Atlanta
Secretary and Treasurer.....James Ferrier, Rome

The Pennsylvania State Gas Association was organized April 14 and 15, 1909, with officers as follows:

President.....E. G. Holzer
First Vice-President.....John Keppelman
Second Vice-President.....E. J. Butterworth
Secretary and Treasurer.....W. H. Merritt

I regret that this list is not entirely complete, but it was found difficult to obtain some details. Indeed, Associations, especially State Associations, have been formed so rapidly in recent years it has required considerable correspondence to find the proper officers, and while all have passed through similar experience as to formation, the precedent established by the earlier organizations made the way both plain and simple.

In the formation of the New England and the American, much of the subsequent growth presumably came from the great influence and wise leadership of the first presidents, Messrs. W. W. Greenough, of the New England, and Gen. Charles Roome, of the American, respectively, whose prominence in the gas world added dignity as well as importance to the movement.

The same is true of Col. Joseph B. Thomas and Eugene Vanderpool in the Society of Gas Lighting, and of J. O. King in the Western. And all of the named ones have passed from the field of labor on which they worked with enthusiasm and faithfulness.

In conclusion, a word should be added calling attention to the still more important and valuable work performed by the Secretaries of the bodies. It would be impossible to praise too highly or even approximate the true value of the services renderd by these gentlemen in the upbuilding of these associations. It is a well known fact that the success of any meeting very largely depends upon the persistent energy and unflagging zeal of the Secretary in charge; and while many names will instantly occur to the reader, of gentlemen who ably graced the office and whose leadership contributed greatly to the welfare of the Association, I cannot refrain from mentioning the name of the late Capt. William Henry White, who displayed particular ability in that office, and whose rare camaraderie made him an ideal illustration of what we owe to them, the benefit of whose labors we continue to enjoy.

A Rapid Review of Gas Manufacture in New York City for the Last Fifty Years.

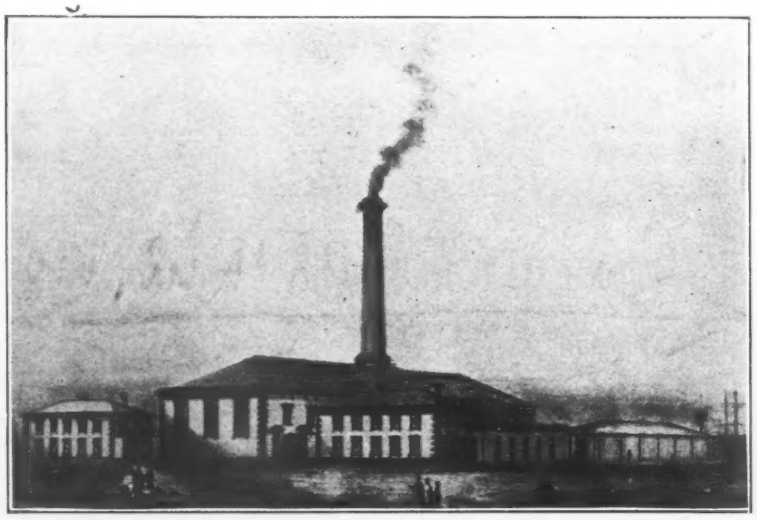
[Prepared by Dr. A. H. Elliott, Chemist-in-Chief, Consolidated Gas Company, New York City.]

Up to the time of the appearance of the American Gas Light Journal, New York City had seen a variety of processes used for the manufacture of gas to supply it with light.

In the early stages of its manufacture, gas was made from whale oil, rosin, and from imported coals of various kinds. About the year 1850, the manufacturers had settled to the use of imported cannel and Newcastle coals, and the two gas companies—namely, The New York Gas Light Company, chartered in 1823, and The Manhattan Gas Light Company, chartered in 1830—had a career sufficiently long to obtain a settled method of manufacture.

At the time of the founding of the American Gas Light Journal, General Charles Roome was Engineer of the Manhattan Gas Light Company, and Mr. John Mowton was Engineer of the New York Gas Light Company. The Presidents of these companies were respectively Mr. Henry Young, of the Manhattan Gas Light Company, and Mr. W. W. Fox, of the New York Gas Light Company.

The New York Gas Light Company was originally situated downtown, and had its works at the corner of Center and Hester streets, and Canal and Hester streets. In 1852 this company moved to its new works, at the corner of Twenty-first street and Avenue A. In the year 1859, it had 496 cast-iron retorts under fire. It had six holders, of one million five hundred thousand cubic feet capacity; it also had smaller holders in Park, Roosevelt,



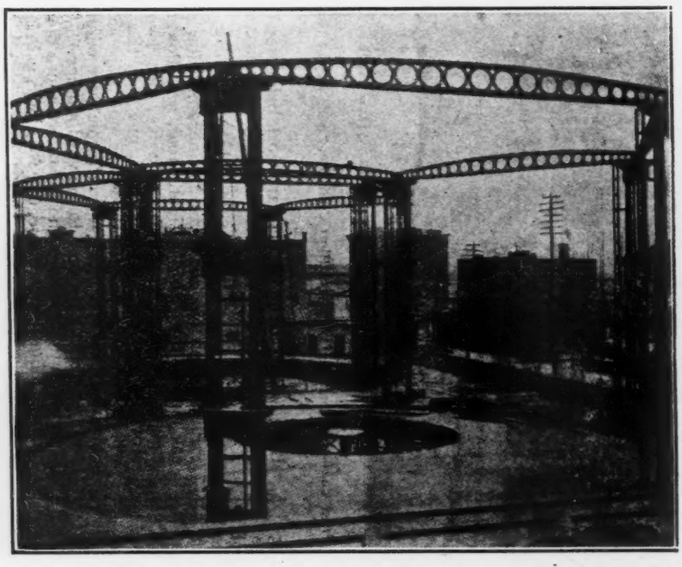
The New York Gas Light Co.'s Works View.

Church and New streets, all downtown. It had 120 miles of mains, and its business was confined to the territory south of Grand street.

The first gas sold by the New York Gas Light Company brought it $10 per 1000 cubic feet, but at the time of which I am writing (50 years ago) gas was being sold at from $2.50 to $3 per 1000 cubic feet. The company supplied about 13,000 consumers and 3100 street lamps. It is rather interesting, in connection with the New York Gas Light Company, to notice that John Mowton, their Manager, had been with them about 25 years, and was originally the Engineer of the Baltimore (Md.) Gas Light Company, which was the first works established in the United States.

The position of the consumers at this time is rather interesting.

Central Gas Light Co. Holder, Mott Haven, now New York City, 1860.

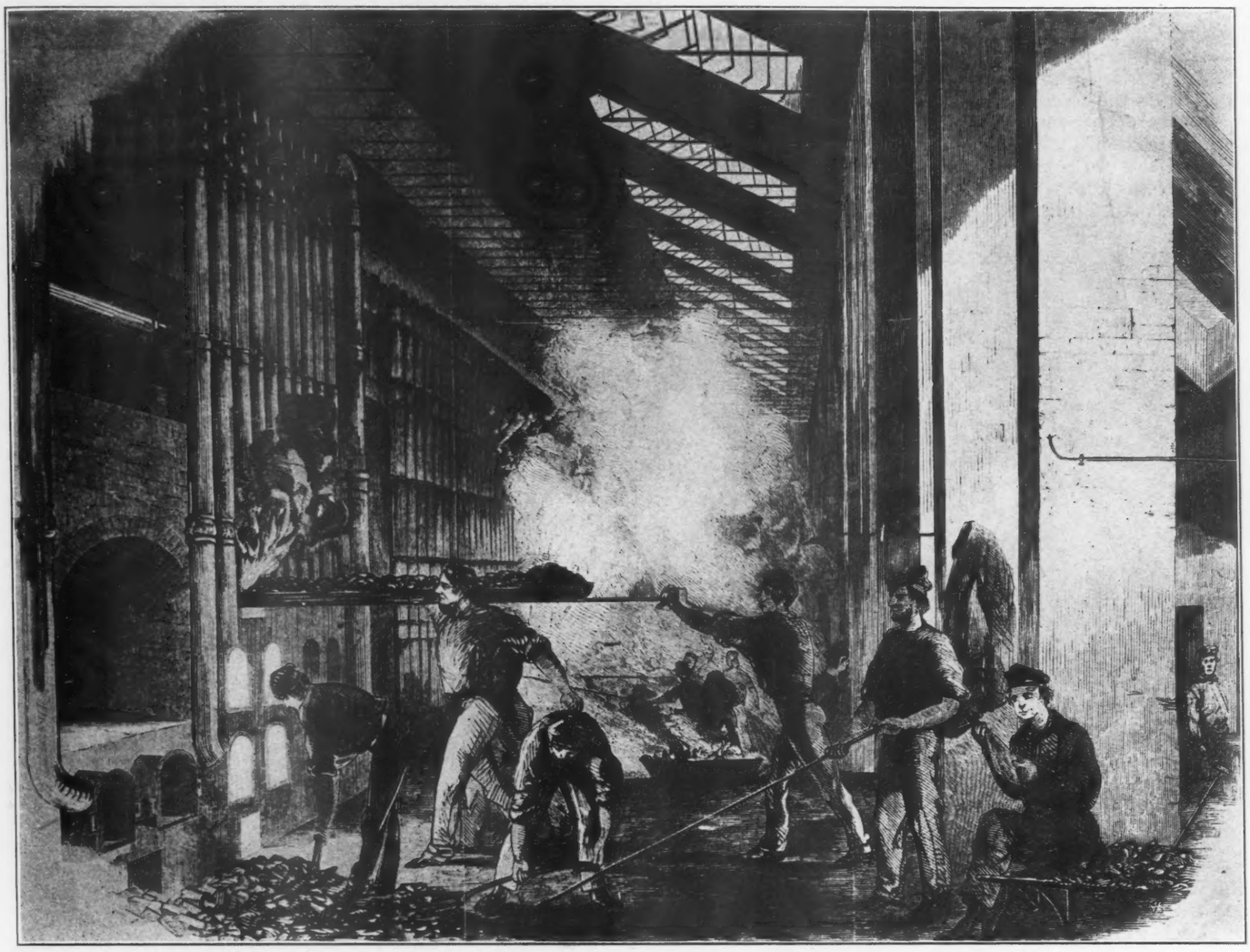


The first Gasholders erected. 21st Street Station. New York Gas Co. 1847

Manhattan Retort House Exterior.

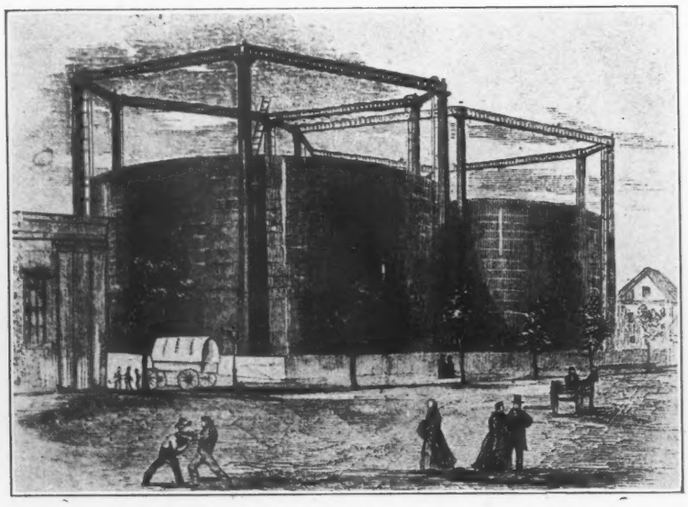
Gas was charged at the rate of so much per 100 cubic feet, for example: In the year 1847 it was sold at the rate of 70 cents per 100 cubic feet; and in the year 1860 it cost 30 cents per 100 cubic feet. Now, in addition to this, there was the rent of a meter to be paid for, which was about 16 cents per month, and, as the company owned the gas fixtures, various prices were charged for these, which sometimes amounted to as much as the cost of the gas itself. And yet we have no evidence that the companies were doing much better, financially, than they are in recent times.

The original works of the Manhattan Gas Light Company was established on the corner of 18th Street and 10th Avenue, and, as stated above, General Chas. Roome was the Engineer.



Manhattan Gas Works. Interior of the Retort House.

Manhattan Gas Works. The Condensers.



Manhattan Gas Works. The Gasholders.

The Metropolitan Gas Light Company was incorporated in 1855, and the Harlem Gas Light Company just about the date of the first issue of the AMERICAN GAS LIGHT JOURNAL—July, 1859.

The output of the various works is rather interesting at this date. In 1859 the Baltimore Gas Light Company, that had been established many years, had 8000 consumers and 1800 street lamps, with 65 miles of mains.

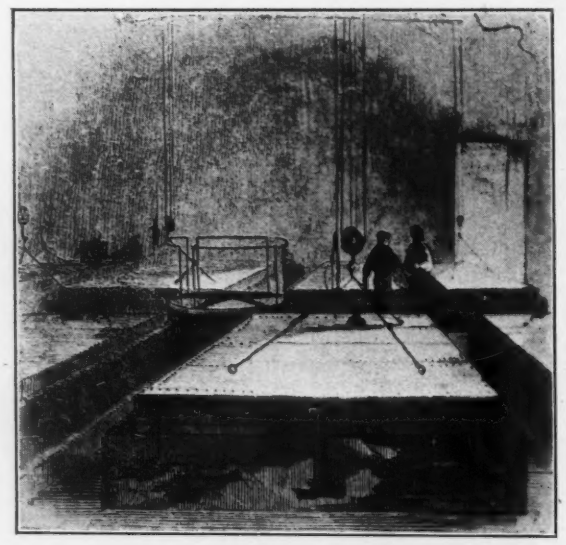
The Boston Gas Light Company had 10,000 consumers and 2200 street lamps. This last company had been established since about 1825.

The New York Gas Light Company had 15,000 consumers and 4100 street lamps, and had been in existence 36 years.

The Manhattan Gas Light Company had been established 29 years and had 25,000 consumers and 8500 street lamps.

It is interesting to notice the names of the different scientific men who were directly or indirectly connected with gas manufacture. We hear of such names as: Prof. W. H. Ellet, Chemist to the Manhattan Gas Light Company; Dr. John Torrey (for a long time in charge of the Government Assaying Office on Wall street), who was succeeded by Carl Schultz (of mineral water

fame); Dr. John Cresson, of Philadelphia; Dr. A. K. Eaton, of New York City; Dr. F. A. Genth, of Philadelphia; Prof. W. Gibbs, Harvard University, Boston, so that at that time the gas manufacture in New York City was not lacking in scientific talent; but, judging from the results obtained, I fear these gentlemen were not very thoroughly consulted, otherwise greater progress would have been made in the utilization of by-products, for we have no records of the use of ammonia liquor, which was run into the

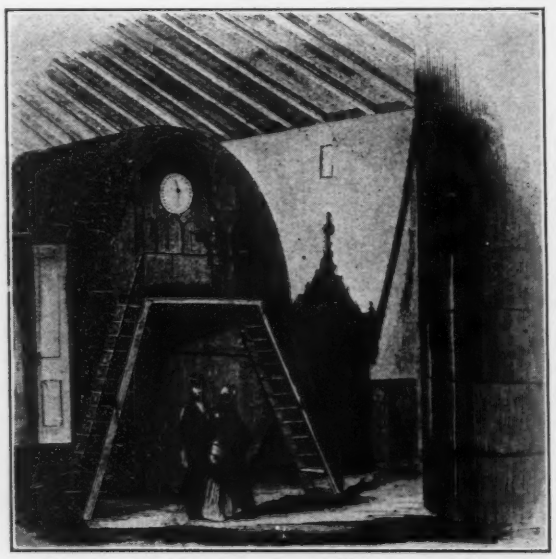


Manhattan Gas Works. The Purifiers.

river; or of any value to coal tar, which was used by certain people in Boston, probably the predecessors of the well-known firm of Cabot.

As soon as the manufacture of water gas at the plant on 44th Street of the Municipal Company proved a success, a number of modifications of it were promulgated. Various developments were the Lowe, Strong, Granger and Wilkinson processes. The only one of these that has survived is the Lowe process, as developed by the United Gas Improvement Company and by Messrs. Humphreys & Glasgow, which to-day is by far the most successful of the water gas processes, although it is not capable of as close regulation as is the Tessie du Motay. It would be impossible to use the Tessie du Motay process with the peculiarly heavy oils, which it is the fate of the gas manufacturer to have given to him at the present time.

A lot of work was done between the years 1880 and 1890, upon the various developments of regenerative gas burners before the



Manhattan Gas Works. The Station Meter.

perfection of the present Welsbach burner. These regenerative burners were not successful, owing to the fact that the rich gases, when superheated, deposited carbon, and the illuminating power of the gas was partly destroyed and the small tubes through which the gases were superheated, choked up with carbon. The advent of the Welsbach burner, in 1885, gave a new impetus to the manufacture of gas and the development of the candle power of the gas was undertaken with a new line of thought, namely, the production of incandescence from refractory substances outside of the carbon contained in the gas itself.

About 1885 the Fahnehjelm burner, with a double row of magnesia needles, in the form of a comb, heated with blue uncarburetted water gas, was introduced, but was not successful.

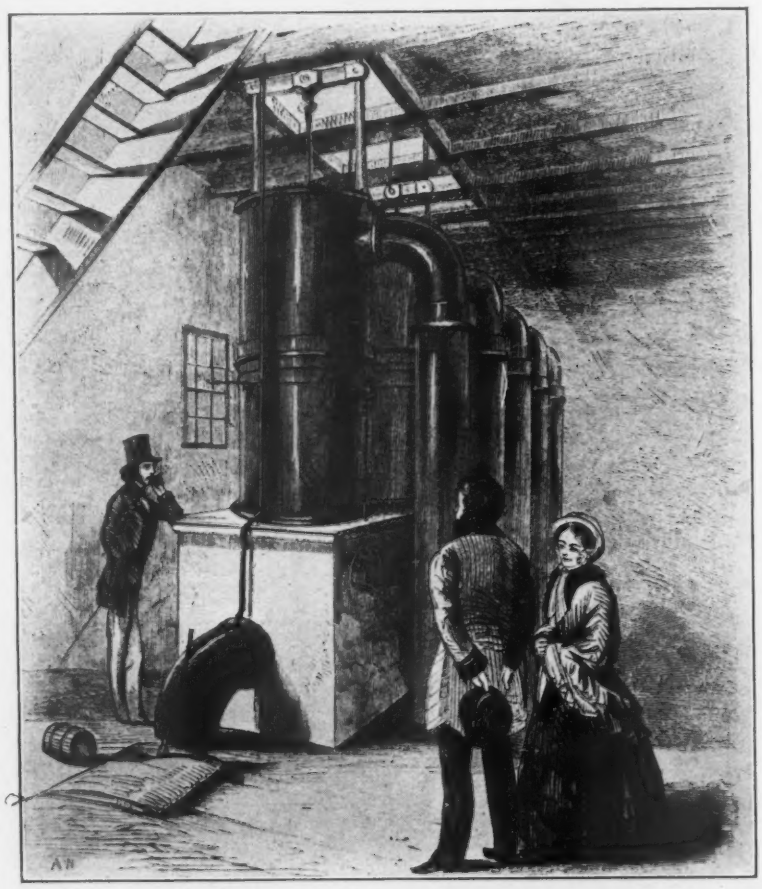
What the development of the Welsbach idea has given us everyone knows.

In old times, five candles to the cubic foot of gas burned per hour was a very good figure. To-day, it is quite easy to get 25 candles, when the gas is burned in a properly constructed Welsbach burner. Various modifications of the Welsbach burner and the Welsbach mantle have been proposed; but practically the invention of Auer von Welsbach to-day is the most successfully developed of the original ideas.

The manufacture of gas from the English coals involved the use of English Cumberland coal, enriched with rosin at first, and afterwards with Breckenridge coal, using from 5 to 15 per cent., according to the candle power needed, which was about 12 to 14 candles.

The ammonia water was sometimes used for fertilizing purposes, but most of the time it ran away into the sewers and thence into the river..

At the time of writing (1859 or 1860) stove coal was worth about $5 per ton, and coke from the gas works was a popular fuel



Manhattan Gas Works. The Exhausters.

in the vicinity of the works. Carts delivered it at $2.50 per chaldron; it was also sold by the bushel, if the consumers would go to the gas works for it.

During the Winter season the gasholders of the New York Gas Light Company were charged with coal tar in the cups, in order to prevent them from freezing, and it was not until 1865 that tar was displaced by the use of steam in the cups; of course, the use of tar did not add anything to the appearance of the holders, from an æsthetic point of view, and our good friends uptown, who object to the color of the large holders now used, would have been greatly worse off those days.

Mr. John Connell, who has been in the service of the New York Company for over 50 years, and who is still hale, hearty and active at the 21st Street station to-day, says that the company did not have its own docks in the year 1859, and had to cart its coal from 18th, 23d and 26th streets, from the docks where the English vessels discharged.

About the year 1860 the first clay retorts were used at the 21st Street station. They were imported from Belgium, were round, 16 feet long, and 14 inches in diameter, They were known at the works as "cannons," and it required picked men to fire them.

The water for the boiler, which supplied the power for the works, was fed from the street mains without pumps, and the highest boiler pressure was only about 15 pounds to the square inch.

The pressure on the street gas mains was about 3 inches near the works, lessened in the remote parts of the district.

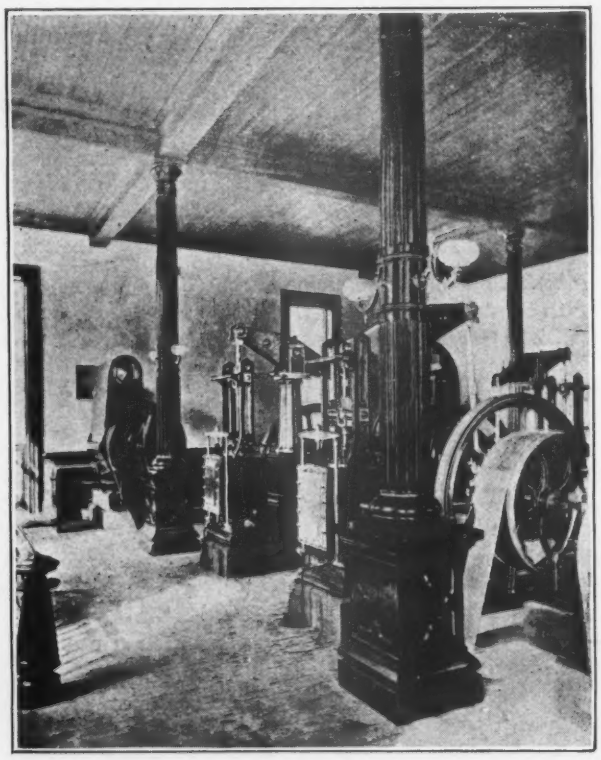
About 1866 a telegraph regulator was added by Mr. Chester, and then the pressure carried was about seven-tenths of an inch in the day time and about one inch at night. As time went on and the services became more remote from the works, additional pressure was required.

It was not until the year 1868 that the coal tar and ammonia appears to have been sold for revenue. About this time the firm of S. Kidder & Co. took the tar, and C. C. Parsons the ammonia.

The manufacture of coal gas in the old New York Gas Light Company's works ceased on the first of May, 1880.

It is interesting to remember that Mr. John Connell claims to have the honor of having worked under eight Presidents, namely, Messrs. Fox, Adams, Everett, Lees, Roome, Smith, Gawtry and Cortelyou. And under Superintendents, Messrs. John Mowton, Chas. Mowton, Masten, Lees and Keegan, a record probably never equaled in the gas manufacturing establishments of the city of New York.

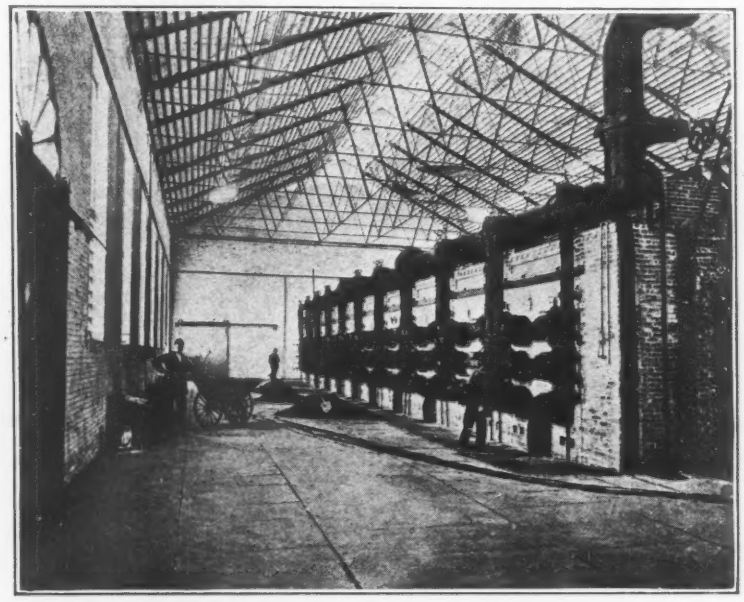
About the year 1875 the idea of making water gas was promulgated, and various methods were suggested. Very soon after



Municipal Gas Works. Engine Room Interior.

this (about 1878) the deliberate manufacture of water gas was undertaken at the Municipal Gas Light Company's works, at West 44th Street, and here, after a great deal of experimenting, it was ultimately made commercially successful.

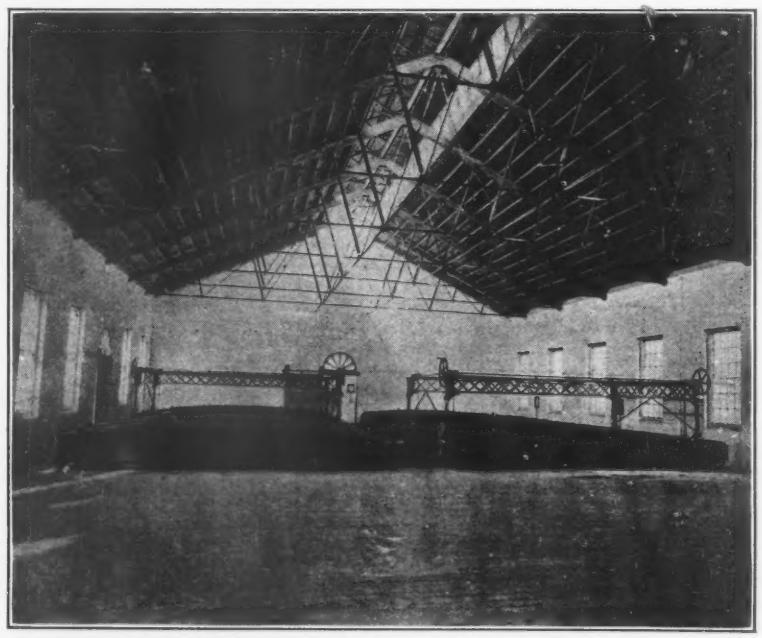
The success of this works is undoubtedly due to the indomitable energy and excellent management of Mr. W. H. Bradley, now the honored Chief Engineer of the Consolidated Gas Company of New York, who saw the possibility of the water gas process as invented by the Frenchman, M. Tessie du Motay; and while the inventor had at no time made a success of it, after Mr. Bradley took hold of it, it began to flourish at once. It was due to another cause, perhaps secondary, but nevertheless of importance, that the method of making water gas from hard coal in generators and carburetting it with petroleum naphtha, depended upon the appreciation of the chemistry of gas manufacture by Mr. W. H. Bradley; for, while he was not a professional chemist, he encouraged in every possible way and used chemistry at every profitable point in the cause of this interesting and novel manufacture at that time. It is true many difficulties were encountered, and those who were not friends of the manufacture jumped at conclusions which were not warranted by the facts as Mr. Bradley knew them, and furthermore, showed gross ignorance of what was being done by the Municipal Gas Light Company around 1880. Some of the unfriendly critics of the process actually undertook to prove that it was physically and chemically impossible to make gas by the Tessie du Motay method, except at a loss, when, as a matter of fact, from the beginning this manufacture was fairly profitable. Then, again, those of scientific standing undertook to prove that the gas was dangerous, and thus bring about an opposition to its manufacture by frightening the users of it; but happily the men at the head of the company were not at all frightened, and bravely continued their very skillful course to the end. Finally, about the year 1884, it became very evident that the manufacturers of water gas knew exactly what they were doing, and the coal gas men became very inti-



Municipal Gas Works. Interior Retort House. Inlet Side.

mately interested with them in the union of the various companies. Since that time the story is too well known to need any comment on my part, and we have only to ask what would New York city have done during the last 20 years if it had not been for the manufacture of water gas, started and successfully carried out at the works of the Municipal Gas Light Company?

The Engineering Fraternity also must not be forgotten in connection with these early developments of gas manufacture in New York City. In conjunction with the Manhattan Gas Light Company, such names as that of Messrs. J. A. Sabbaton, C. V.



Municipal Gas Works. Purifying House.

Smith, A. M. Smith, his brother, who continues in good health and as Engineer of Distribution of the Consolidated Gas Company of New York, is still in harness to-day.

In conjunction with the New York Mutual Gas Light Company the names of Messrs. J. P. Kennedy, Samuel Parham, Harry Allen, Walter Allen and Dr. A. W. Wilkinson are well known. This company made wood gas for a number of years, and also reburned its waste lime for the purifiers.

In the New York Gas Light Company, Messrs. George W. Doane, Dr. T. O'Connor Sloane and Mr. William T. Lees are not

forgotten. Mr. Lees has passed away, but we are glad to record that Dr. T. O'Connor Sloane is still with us and doing much good work, especially in the literary field. Mr. Geo. W. Doane is now President of the New Amsterdam Gas Company, and apparently good for many years of usefulness.

In the Harlem Gas Light Company, such men as Messrs. Henry O. McGowan and Burr Wakeman, were early Presidents, and Mr. John Balmore, the Engineer, are still remembered.

In the Metropolitan Gas Light Company we must mention the

Municipal Gas Works. Carburetter Room.

Zollikoffers, father and son; also Alex. H. Strecker, the Engineer, still with us and as good as new in his chosen work in their works in New Jersey.

The various cuts presented here are from original pictures and photographs that have been carefully preserved from time to time, and will be interesting more or less to those who have put their best days into the problem of lighting the city of New York with gas.

From these fragmentary notes, a picture of the past may be built up. To the young men of the fraternity let us hope that they will be useful in showing the pathway already traversed, and as beacon lights to achievements not yet thought of.

Fifty Years of Street Lighting in the City of New York.

[Prepared for the JOURNAL by MR. H. THURSTON OWENS.]

The era of public lighting dates back many centuries, but such lighting was not provided in a manner at all adequate, until gas became available, and although it is nearly 100 years since the first gas company was started in the United States, public lighting did not receive anything like the attention which it truly deserved until about fifty years ago.

New York was the third city to have a gas works, having been preceded by Baltimore and Boston. On May 12, 1823, a franchise was granted to the New York Gas Light Company for a period of 30 years. It was specified that the gas was to be of a quality, brilliancy or intensity equal to the gas in use for the public lamps in the City of London, England. The public lamps were furnished at a price equal to that charged for the sperm oil lamps which they superseded. This Company operated south of Grand Street. On May 8, 1833, a franchise was granted, for a period of 20 years, to the Manhattan Gas Light Company, to operate north of Grand Street. The conditions regarding the quality of gas were similar to those in the other company, but the price for public lamps was made $15 per annum.

It was not until 1853 that the gas lamps exceeded the oil lamps in number, and in this year the "Moonlight Schedule" was abolished, the hours of lighting being increased from 2300 to 3833 1-3.

In 1855 the third franchise was granted to the Harlem Gas Light Company to operate north of 79th Street.

The number and price of lamps in the year 1859 are given in Table I.:

TABLE I.—Showing lighting conditions in the City of New York in 1859.

Square miles	21
Population	813,669
Street lamps	13,443
Price per annum	$25.00 to $28.80
Cubic feet per burner	3
Hours of lighting	3,238
Annual cost	$400,000

In addition to the above a few oil lamps were still in use in the upper part of the city, being cared for by municipal lamplighters. These were soon after replaced by gas lamps.

The Mayor of the city in 1859 was Mr. Daniel F. Tiemann, and the Street Commissioner, Mr. G. W. Smith. The Bureau of Lamps and Gas was in charge of Supt. Wm. Gayte, and his Clerk was Mr. Stephen McCormick, who later became Superintendent. The present Engineer of Distribution of the Consolidated Gas Company, Mr. A. M. Smith, was Superintendent of the New York Gas Light Company. Harry Howard was Chief Engineer of the Fire Department. It was in this year that the first State Inspector of gas meters and the first City Inspectors of lamps and gas were appointed.

The Metropolitan Gas Light Company received a franchise, in 1858, for a period of 30 years, for the district between 34th and 79th streets. They did not supply street lamps until 1864, at which time some 3,000 lamps of the Manhattan Company were transferred to them.

GAS COMPANIES.

Gas lighting had assumed considerable proportions in the Metropolitan District prior to the introduction of a technical paper devoted to these interests, as will be seen from the companies given in Table II.

TABLE II.—Showing gas companies incorporated in and near New York City prior to 1860:

Year.	Gas Light Company.	Location.
1823.	New York	New York City
1830.	Manhattan	"
1853.	Metropolitan	"
1857.	Harlem	"
1857.	Staten Island	Staten Island
1825.	Brooklyn	Brooklyn
1850.	Williamsburg	"
1853.	Greenpoint	"
1859.	Citizens	"
1855.	Flushing	Long Island
1856.	Jamaica	"
1858.	Astoria	"
1859.	Hempstead	"
1854.	Yonkers	Westchester County
1859.	Morrisania	"
1859.	Tarrytown & Irvington.	"
1853.	Jersey City	Jersey City, N. J.
1856.	Newark	Newark, N. J.

Shortly after this, gas companies were started in Port Chester, New York and Plainfield, N. J., in 1860; East New York, L. I., in 1861; Hoboken, N. J., in 1862, and Hunters Point, L. I., in 1863.

In 1863 the four gas companies in New York City, which had a combined capitalization of $7,900,000, agreed to a certain division of territory, and the prices for street lighting were almost doubled. By 1865 the number of lamps had increased to 16,294, but owing to the increase in prices, no contracts were made until 1873.

In the year 1870 the population had increased to nearly 950,000, and a fifth gas company, The New York Mutual Gas Light Company, was started in 1872, and the competition soon began to be felt, so that in 1873, when contracts for a period of one year were awarded, the prices were considerably reduced, notwithstanding the fact that they contained numerous exactions as to candle power and quality which had not theretofore been demanded. The number of lamps had reached 17,666.

The year following a large section north of the Harlem River was annexed to the city, which included 2,515 more street lamps. The companies supplying this territory now known as the Borough of The Bronx, were the Central, Northern and Yonkers Gas Light Companies. The Municipal Gas Light Company and the Knickerbocker Gas Light Company were supplying gas in Manhattan in 1876, but they did not supply any street lamps. In that year Mr. Stephen McCormick was made Superintendent of Lamps and Gas.

By 1879 the number of lamps had reached 21,029 and the population of the city 1,200,000. In this year the lamps in the public parks were placed in charge of the Superintendent of Lamps and Gas.

In 1880 both the New York and Knickerbocker Companies began to supply water gas. Shortly after, 6 of the 10 companies were merged into the Consolidated Gas Company. The consolidation was completed in November, 1884. This left the Mutual Gas Light Company as the only competitor for gas supply on Manhattan Island.

Naphtha Lighting.—For fifty years gas had been the undisputed peer of all illuminants used for public lighting, but in the year 1877 over 2,000 lamps, supplied by the Harlem Gas Light Company, were discontinued and naphtha lamps substituted in lieu of same. This was only a temporary setback, however, as in the following year only 506 were continued in use, and by 1880 all of the naphtha lamps had been removed. They were not again used until 1885.

Lighting Hours Increased.—Competition always increases the interest in the use of a commodity, and in 1879 the timetable for lighting was increased from 3,833 to a full 4,000 hour basis. It was also suggested to increase the consumption of gas lamps from three to four cubic feet an hour, but this was not adopted.

Electric Lighting.—Timid investors in gas stocks received another rude shock in 1878, when Jablochkoff lighted the Avenue de L'Opera, Paris, France (August, 1878), with 22 arc lamps. Stocks went down, as they had previously in London, England, when an electric lamp was brought out in 1848. It is needless to say the fears of gas shareholders were unwarranted, as the arc lamps were shortly after discontinued, owing to their great expense.

In the same year three arc lamps were installed (August, 1878) at Manhattan Beach, Coney Island, and later before a number of stores in the city. Edison had also succeeded in sub-dividing the electric current,[1] but the incandescent type was not used for street lighting until a number of years later.

In 1880 the Brush Electric Light Company erected 23 lamps on ornamental iron poles on Broadway, between 14th and 34th Streets, and December 20 of that year, 15 of these were lighted. On January 15, 1881, the remaining 8 were started. These lamps were continued until May 1, without charge as a demonstration, and then a contract was made for 55 lamps at $7,400 per annum. Twelve of these were used for park lighting, there being 6 each in Union and Madison Parks, being installed upon poles 160 feet in height.

At the end of 1882 there were 128 arc lamps in use, and they rapidly came into favor. In 1884, there were 647; 1886, 711; and in 1888, 1,328.

The expense of public street illumination had been considerably increased by the introduction of electric lighting, as the 1,328 arc lamps cost $170,860.15 per annum, displacing 6,465 gas lamps, costing $110,330.50.

The fact that competition increases business is well exemplified by the fact that, in spite of the loss sustained by the lamps discontinued, there were more gas lamps than before, after four years of electric lighting. Namely, 22,732.

In addition to these, 120 naphtha lamps had been erected in Woodlawn Heights (1885), to which district gas mains had not been extended. In 1885 and 1886 the Legislature "investigated" the gas companies of New York City. The total cost of street lighting, in 1888, was $632,000, the population being nearly 1½ millions.

Electric Light Poles Cut Down.—The following year was decidedly unfavorable for the 6 electric light companies doing business at the time. A number of persons were killed by coming in contact with live wires and, after considerable litigation, Mayor Grant ordered all poles carrying overhead lines cut down. The result was that, at the end of 1889, there were only 145 arc lamps in service, while the gas lamps had increased to 28,029 and the naphtha lamps to 126.

Early in 1890 a number of electric lamps were relighted, and of the 4,378 gas lamps which had been relighted, 2,793 were again discontinued. On January 1, 1891, there were 27,114 gas, 138 naphtha and 881 arc lamps in use, a total of 28,133 lamps.

The Standard Gas Light Company, chartered in 1886, started to supply lamps in 1890, taking over some 2,000 lamps of the Consolidated Gas Company and at a lower price. The next company to receive a charter was the New York and East River Gas Company, in 1892, which began to supply gas in 1894, shortly after the tunnel was completed under the East River, between Manhattan Island and Long Island City, or Ravenswood. This was the first tunnel successfully completed under the navigable waters around New York.[2]

In 1894 the New York Mutual Company ceased to supply street lamps. In 1896 the villages of Wakefield, Eastchester, Williamsbridge, the town of Westchester, and portions of the towns of Eastchester and Pelham, were annexed to the city. This brought more companies and lamps, so that, December 31, 1896, there were 4 gas and 7 electric companies supplying Manhattan; 3 gas and 3 electric companies supplying what is known as The Bronx; and a naphtha company supplying both, the lamps numbering 30,200: Gas, 25,544; electric arc, 3,460; electric incandescent, 68; naphtha, 1,128.

Broken Glass.—Breakage of glass had always been a source of great trouble and annoyance, and to illustrate the extent of this it was reported that over 125,000 pieces of glass and nearly 2,000 globes were required in that year for replacement.

Greater New York.—On January 1, 1898, the dreams of the late Andrew H. Green were fulfilled, and all of the Metropolitan District in the State of New York became Greater New York, the area increasing from 60 to 307 square miles, comprising the cities of New York, Brooklyn, Long Island City and 82 towns and villages.

The year 1899 saw the gas companies in Manhattan and The Bronx involved in a "war," with the result that the Consolidated Gas Company acquired control in the following year of all, with the exception of two small companies, supplying outlying sections in the Borough of The Bronx, and later this company also acquired the electric lighting companies.

By the end of 1901 there were over 61,000 public lamps in the city, over one-half of which were open flame gas lamps. The mantle type of gas lamp, which was introduced in 1896, numbered about 8,000. Except for a slight increase in number, there was no material change in the lighting conditions, until 1904, when some 17,000 open flame gas lamps, in the Boroughs of Manhattan and The Bronx, were changed to the mantle type, and in the following year the majority of the lamps in Brooklyn and Queens Boroughs were also changed. In addition to this improvement, the wattage of a large number of electric lamps in the Borough of Brooklyn was increased, and practically all of those remaining in Brooklyn and in Queens were changed in the present year, so that practically all of the arc lamps are now of the standard 450-watt size. Since October, 1905, the lighting hours have been 3,950 hours per annum instead of 4,000 as heretofore.

Some time prior to consolidation, gas lamps were in use in the Borough of Richmond, Staten Island, but were replaced by electric lamps, but in the village of Tottenville, Staten Island, 100 kerosene lamps remained in use until the end of 1906. Gas lighting came into its own in this borough in 1908, when over 200 gas lamps were installed, replacing electric lamps.

In 1907 tungsten incandescent lamps, of the series type, were installed in the Borough of Queens, and in the following year the multiple type was used in the Borough of Manhattan. The lamps of this type which were installed in the Borough of Queens replacing naphtha lamps upon outlying roads, gas not being available. The same applies to the Borough of Manhattan, except that they were installed in Riverside Drive and other parks. The lamps in use at the present time throughout the Greater City are given in the following table:

[1]Menlo Park, N. J., February, 1879.

[2]American Gas Light Journal, Vol. LXIII., p. 84.

TABLE III.—Showing lighting conditions in the City of New York in 1909:

Square miles		307
Population		4,493,118
Street Lamps.	Number.	Price.
Mantle gas	43,929	$22.37 to $28.00
Open flame gas lamps	128	14.89
Mantle naphtha lamps	3,324	28.00
Open flame naphtha lamps	12	22.50
Incandescent electric lamps	6,532	22.50 to 31.54
Arc lamps	15,441	95.00 to 102.56
Total	69,366	
Hours of lighting		3,950
Annual cost		$3,000,000.00

The quantity of gas used for public lighting is, in round numbers, 600,000,000 cubic feet, and exceeds the output of any plant in the State of Massachusetts, with the exception of the two largest. It must be remembered that this seemingly enormous quantity represents less than two (2) per cent. of the total output in the whole city.

NAPHTHA LIGHTING.

At the Centennial Exposition, Philadelphia, 1876, one of the lamps destined to play an important part in street lighting, namely the naphtha lamp, was exhibited. They were introduced in New York in 1877, and to-day over 50,000 are in use in this country.

The original burners were of two types—jet and flat flame; and although the former could be operated in a round globe, the latter type, enclosed in a square lantern, proved the most successful.

The round or "boulevard" globe came with the introduction of mantle naphtha lamps in 1898. Naphtha lamps have found great favor on account of being a self-contained unit, no wires or conductors being necessary for their operation.

They have always been an expensive lamp, as compared with gas, and the margin is increasing in favor of the latter, for the price of gas is going down, and naphtha is, as to price, becoming almost a luxury.

In 1908 the price was increased to $28.20, with the result that tungsten incandescent lamps, of 40 nominal, candle power, at a cost of $28 per year were substitued.

OIL LAMPS.

In 1762 oil lamps were first installed upon wooden posts, and maintained at public expense. This type, although done away with on Manhattan Island in 1860, was again found in the City of New York upon the annexation of Staten Island. There were 100 of these lamps in use until displaced by electric lamps in 1906.

WELSBACH LAMPS.

In the early nineties a number of cities in Germany installed Welsbach lamps for street lighting, with varying success, and our American engineers watched these developments much the same as they now are watching the use of the inverted type to-day. In the summer of 1894 four lamps were installed at the Worth Monument, Broadway and Twenty-fifth street. During 1896 the first large installation was made upon the Boulevard, north of Fifty-ninth Street, when 174 double burners were installed.

Of course, the use of mantles for gas street lighting not only saved the day for the industry, but also revolutionized the general public impression regarding this necessity, if the attitude of the small boy be any criterion. Gas lighting has never been subject to the interruptions of service which characterized electric lighting for many years, and is even to-day a great drawback to it where overhead wiring is in vogue.

New York has never seen all of its gas lamps out of commission for any cause, for even when the city would not agree to pay the prices asked by the companies, the lamps were furnished until satisfactory terms could be made. This has not been true in all cities, a notable instance being that of San Francisco, in 1883, when the number of lamps was reduced from 5,438 to 3,000, and later on all were discontinued through lack of funds—such was the reason given at the time. The lawlessness which followed was indescribable.

Although, as stated, all of the lamps were never discontinued even during lamplighters' strikes, the small boy, and sometimes his older brothers, always considered the public gas lamp a natural target. Thousands of pieces are used every year for repairs, running as high as 8 pieces per lamp per annum.

The advent of the mantle lamp wrought a great change in this practice, undoubtedly due to the improvement in utility and appearance of this equipment. In 1903 the city refused to accept the bids offered by the lighting companies, due principally to the prices asked for arc lamps, and in 1904 the lighting companies offered to reduce the price of Welsbach lamps from $28.75 to $24.75, provided all of the open flame lamps were changed over.

The open flame lamps consumed 3 cubic feet per hour, gave about 12 candle power, and cost $18 per year, whereas the mantle type gave 60 candle power on 3½ cubic feet. The bid was accepted, and practically all of the lamps in Manhattan and The Bronx were changed during 1904. The following year the lamps in Brooklyn and Queens Boroughs were also changed.

Contracts for gas lighting until 1906 were divided in two parts, one for erecting and repairing the posts supplied by the city, the other for lighting, cleaning, extinguishing and supplying gas. As the question of price was still unsatisfactory to the city, the supply of gas was made a separate contract, the price which has since been mandatory at 75 cents by legislative act.

CANDLE POWER.

The question of candle power of lamps used for public lighting is of comparatively recent origin. The original lamps were supposed to consume 3 cubic feet per hour, and this quantity for open flame burners has remained unchanged ever since. The standard candle was not adopted by the London Gas Referees until 1866, and a candle power standard for the gas supplied was not included in the contract specifications until 1873. Three years later the photometric laboratory of the city was opened under the direction of Dr. E. G. Love, the present Chief Gas Examiner of the city.

When mantle gas lamps were installed in 1896 the quantity of gas supplied to each lamp was increased to 3½ cubic feet, and the candle power requirements were 60. as against 12 for the open flame burner, consuming 3 cubic feet.

In 1888 and 1889 the arc lamps were tested, as to candle power and consumption of current, for the city by Capt. John Mills. The contracts for the year 1889 called for a lamp of not less than 1,000 candle power, measured 40° below the horizontal, and to consume at least 425 watts.

The Brush lamp, tested in 1888, was of 1,535 candle power and consumed 447 watts; the Jenny, 1,401 candle power with 732 watts. A test made one year later is still quoted as authoritative by Foster's Handbook, as witness: 2,034 candle power at 490 watts.

Numerous tests were made which gave somewhat similar results, but these have been explained somewhat jocosely by the fact that if an arc be hung over the center of a square, formed by two intersecting streets, it would throw light down each one equal to 500 candles, and therefore was a 2,000 candle power lamp.

The testimony given before the Arbitrators of the Colorado Springs Controversy[3] would indicate that a freak reading might give such results.

Prof. Matthews stated that an open lamp giving 2,000 candle power would require 30 amperes. In this connection it may be interesting to note that the average *maximum* candle power of the present form of enclosed arc lamp was stated by the General Electric Company's expert to be:

A.C.	enclosed	6.6	amp.	430	watt,	480	candle power.
A.C.	"	7.5	"	450	"	550	"
D.C.	"	6.6	"	450	"	650	"

Thus, the average candle power of these lamps is quite within reason, especially as the mean spherical candle power is less than one-half the maximum values given.

Posts.—The first lamps provided for the purpose of public lighting were placed upon window sills or railings, or were supported by brackets, and the first posts were made of wood. The lamps, burning sperm oil, were placed upon the top, much the same as at present in the rural communities. Many of these posts were replaced by those of cast iron shortly after the introduction of gas lighting in the City of New York, but many remained standing as late as 1859. Nearly 700 which had been removed from the streets were sold at auction in 1858, for 38½ cents a piece. Sperm oil lighting was discontinued in New York shortly after this time.

[3]Colorado Springs Controversy, by Henry Floy, 1908.

The iron posts have been made in three styles: 3-piece, foundation, butt and column; 2-piece, base and column; and 1-piece. The 2-piece post is illustrated in Fig. 1. It has been found the most satisfactory of the three types and is the one in general use to-day. These posts have usually received one coat of first quality paint each year, and it may be interesting to note that the posts in Paris

Fig. 1.—Regular Mantle Gas Equipment.

were covered with copper by an electro plating process in 1864.[1] Upon the completion of the Boulevard north of 59th Street in 1872, a somewhat more elaborate post was installed, being named the "Boulevard post." (See Fig. 2.)

Fig. 2.—Tungsten Incandescent Lamp.

Posts for gas lighting in the city of New York have always been furnished by the municipality, whereas naphtha and electric posts are supplied by the contracting companies. In early years the painting of gas lamp-posts was done by city employees, but for a considerable period this has been taken care of by the companies.

The first electric posts were of iron, cast in three sections, the lamp being about 20 feet above the pavement; the later lamps were hung upon the wooden poles. The first ornamental poles were installed upon Fifth Avenue, in 1892, equipped with twin lamps.

In 1896 an ornamental cast iron post, known as the "Bishop's Crook," shown in Fig. 3, was introduced, and these have been installed upon all of the main thoroughfares. In this type of post the lamp hangs quite close to the curb, and they are, therefore, not

Fig. 3.—Standard Arc Equipment.

suitable on streets lined with trees. In order to overcome this objection, the post known as the "Mast Arm" was brought out in 1908, which is 20 feet in height, with an arm 12 feet long. These

Fig. 4.—The Original Type of Gas Lanterns.

[1] American Gas Light Journal, Vol. V., p. 200.

were installed in 1908 upon the two prominent boulevards in the city, Broadway and Seventh Avenue. There are center plots on these streets, and lamps were installed in these of the "Lyre-Top" pattern, where the lamp is suspended directly over the post. There are 60 lamps to the mile upon these streets, which is at least one-third more than had been the custom.

Lanterns.—The first lanterns, which were hung on street corners in the city of Paris in 1558,[5] were made of linen and the illuminant a candle. When it was desired to use oil lamps for outdoor lighting, considerable trouble was experienced on account of deposits of soot due to improper ventilation.

Comparatively few of the accessories used for gas street lighting saw their inception in the United States. The invention of the square lantern, however, is credited to one of our most illustrious citizens, Benjamin Franklin, and it is recorded in his "Memoirs" that the globes formerly used had no air holes at the bottom. He designed a lantern, in 1757,[6] with four panes of glass and an opening in the bottom for ventilation.

This type of lantern was used upon the first introduction of gas lamps in New York City, and upward of 100 may still be found upon the streets. The one shown in Fig. 4, being reproduced from one of the early numbers of the American Gas Light Journal, published in 1859. The form of mail box illustrated was patented in that year, but did not come into general use.

Fig. 5.—The First Boulevard Globe. (Miner's)

The first round globes which were used successfully were patented in 1866, by Mr. J. G. Miner, shown in Fig. 5, the "Reflector" and "Ventilator" being supported by four arms. Later, the globe, known as "Bartlett's Boulevard," shown in Fig. 6, was designed. In this form the globe rested upon the lamp frame and the ventilator was attached to the globe itself. Over 2,000 of these were in use as early as 1873. When Welsbach lamps were first installed in New York, in 1896, this globe was used, but next year a lantern was brought out by the Welsbach Company which was found much more satisfactory for the mantle burner, as the lower portion is provided with a wind shield and a proper ventilator at the top similar to that shown in Fig. 1.

The round globe was tried in 1879, with naphtha lamps, but was not found satisfactory with the flat flame burners. This type of lantern was not used successfully on naphtha lighting until the introduction of the mantle type in 1898.

Burners.—Burners used for street lighting have been very much of the same type as those in use for interior work. Lava, steel and aluminum tips for open flame burners were installed in the order given. Regenerative lamps were placed upon Lenox Avenue in 1889, but were not found to be successful.[7] The Scott-Snell Self-intensifying Lamps, which have been used successfully in London, were also tried, but no installations of any importance have been made in this country. In this connection it may be noted that a rather curious invention was brought out in 1897 for furnishing hot water to buildings, obtained from coil, placed above lantern.[8]

Mantle burners were introduced in 1896, and some 43,000 of this type are in use in the city at the present time. About ten years after they were brought out a volumetric governor was perfected, and it was then found necessary to use a chimney in order to obtain the proper combustion.

Regulators.—The types of Regulators have been as many and varied as those of reflectors. Three types in use in 1862 were described by Mr. Samuel Hughes, "Diaphragm," "Mercury Float" and "Magnetic Contact."[9] Volumetric governors were successfully introduced in 1906. Practically all of the gas lighting in the United States is low pressure, although both high pressure gas and high pressure air have been introduced quite extensively abroad.

Reflectors.—Much has been written in recent years regarding the value of reflectors in street lighting, and it may be truly said that in this case "History repeats itself." As early as 1766 Abbé

Fig. 6.—Ornamental Cluster of Bartlett's Boulevard Globe.

Matherot de Preigney was allowed a patent for the introduction of reflector lanterns in France.[10] Almost 100 years later, 1860, Degrand's lenses were adapted for use on street lamps in Paris, and it was claimed that the light was increased over five-fold.[11] The following year mirrors were placed in the top of lanterns used in Brussels.[12] The next year "Barnett's Porcelain Reflectors" were introduced in France, and were used much the same as the mirrors.[13]

In Miner's globe lamp, patented in the United States in 1866, shown in Fig. 5, a reflector of enameled tin was placed outside of the globe, "so situated as to reflect the light outwardly and downward to the best advantage." About 1882 Trotter's "Dioptric Lantern" was brought out, and later on "Fredureau," also "Holophane" globes, were introduced.

All of the various types of reflectors described have been introduced in divers forms at many periods during the past 50 years, but to-day the vast majority of street lamps in use are equipped *without* reflectors.

[5] American Gas Light Journal, Vol. V., p. 145.
[6] American Gas Light Journal, Vol. I., p. 181.
[7] American Gas Light Journal, Vol. LII., p. 521.
[8] Ibid, Vol. LXVII., p. 611.
[9] Ibid, Vol. LXVII., p. 611.
[10] American Gas Light Journal, Vol. V., p. 145.
[11] American Gas Light Journal, Vol. II., p. 347.
[12] American Gas Light Journal, Vol. II., p. 156.
[13] American Gas Light Journal, Vol. II., p. 251.

Lighting and Extinguishing.—Many inventions have been brought out to supplant the lamplighter, but until within recent years none have been found successful. In 1859 "Symmes' Extinguisher" was introduced. This consisted of a gasholder float on each burner, which lowered upon a reduction of pressure, and remained sealed in mercury until raised by hand at the next lighting.[14]. This last operation was not a serious drawback, as ladders and tapers were in general use at that time. In the same year a lamp at Broadway, southeast corner Canal Street, was lighted by means of an electric magnet. An oil lighter placed upon a stick was brought out in 1862.[15] Still another was patented in 1868, but they were not adopted in the City of New York until 1874. In 1877 Bartlett's automatic electric system was tried without success.

In 1893 an electric device was introduced in which the valve was opened by a magnet burner lighted by a sparker from an electric battery. Electrical contact was obtained by means of an increase in gas pressure.[16] More recently valves have been operated by means of pressure, and the lighting done by means of a pilot. Clocks and pilot lights have also been used. Neither clock nor pressure control has received the attention it deserves in this country; but both are destined to play a most important part in the future of gas street lighting.

Ornamental Lamps.—The candle power requirements, as far as gas lamps are concerned, have always been somewhat lower in

Fig. 7.—The Oldest Gas Lamps in New York City.

New York than in other large cities of the world. This was not due to the candle power of the gas, but to the small quantity; namely, three cubic feet. This figure was established shortly after the first lamps were installed, and in 1879 it was found that this quantity was exceeded in the following cities: Boston and Chicago with 4 cubic feet; Philadelphia with 6 cubic feet; and some of the lamps in Paris consumed 7 cubic feet.

When the location demanded more than the usual quantity of illumination it was provided by means of two and three burners in each lamp. These were usually to be found in front of churches, hotels, clubs and other semi-public buildings, a popular type being shown in Fig. 8. From time-to-time these were discontinued in large numbers, the last "raid" of importance being made in 1872 and 1873, when 768 were discontinued. Where two entrance lamps had been installed, these were not disturbed, and at the time mentioned, there were 738 of these lamps in use.

Mayors' Lamps.—One feature of special lighting, probably an heirloom from our British ancestors, is that of lamps at the residence of "His Honor, The Mayor." These lamps have not been disturbed during the lifetime of the Mayor, or his immediate family. At present there are seven pairs of these lamps in use, and a number of others in place, but not lighted. The lamps shown in Fig. 7 were erected in 1848, before the residence of ex-

[14] American Gas Light Journal, Vol. I., p. 85.
[15] American Gas Light Journal, Vol. II., p. 266.
[16] American Gas Light Journal, Vol. LIX., p. 866.

Mayor James Harper, on Gramercy Square, West, and, to the writer's knowledge, they are the oldest lamps to be found in the City of New York.

Special Lamps.—Along in the '70s the European custom of placing several lanterns upon a single post became quite popular in New York, one of which is illustrated in Fig. 6. There was hardly a square of any prominence which did not have one or more of these or similar clusters, but practically all have been removed by this time. A single lamp, which was also very popular, known as the Eureka pattern, is shown in Fig. 8.

Gas Companies' Lamps.—The majority of gas companies have installed entrance lamps before their offices and works, but they have not, queer to relate, received the care or attention shown the regular public lighting fixtures.

Fig. 8.—The Eureka Lantern.

Fire Alarm Lamps.—In December, 1879, it was decreed by the Common Council that "Red glass be placed in the top of the nearest gas lamp to a fire alarm box." By 1894 over 500 regular fire alarm signal posts were in use, equipped with boxes, the lanterns having red glass sides and tops.

Street Sign Lamps.—In 1896 a number of street sign lamps were erected which were lighted by open flame gas lamps; others were installed later, equipped with incandescent electric lamps. These were discontinued permanently in 1905. The custom of placing glass signs upon the regular lamps has continued without interruption, and practically all of the corner gas posts and electric posts supplied from underground service are so equipped.

Letter Box Posts.—Dead gas posts upon which letter boxes had been placed were considered unsightly, so permission was given in 1896 to cut the columns off and cap with a supposedly ornamental ball, painted with aluminum bronze.

Supervision.—The authority for the installation of additional lighting had been in the hands of the Common Council or Board of Aldermen until 1901, when the Bureau of Lamps and Gas was transferred from the Department of Public Buildings, Lighting and Supplies to the Department of Water Supply, Gas and Electricity, under the revised charter. From 1873 to 1898 all contracts for public lighting required the approval of the Gas Commission, consisting of the Mayor, Comptroller and the Commissioner of Public Works. Since 1901 the money authorized by the Board of Estimate and Apportionment has been expended at the discretion of the Commissioner of that Department. The lighting has been in direct charge of the Superintendent of Lamps and Gas, and for over a quarter of a century the Superintendent was Mr. Stephen McCormick. Upon his death in 1902 the office was abolished, and shortly after the present incumbent, Mr. C. F. Lacombe, was made Chief Engineer of Light and Power.

APPENDIX.

Chronology.

Year.	
1697.	First street lighting ordinance passed in New York City.
1757.	Square lantern invented by Benjamin Franklin.
1762.	First public oil lamps installed in New York City.
1807.	First type of street gas lighting in London, England.
1816.	First gas company incorporated in the United States—Baltimore.
1822.	Second gas company incorporated in the United States—Boston.
1823.	Third gas company incorporated in the United States—New York City.
1823.	Gas lamps introduced in New York City.
1825.	Gas lamps introduced in Brooklyn, N. Y.
1830.	Manhattan Gas Light Company started.
1831.	First Superintendent of Lamps and Gas appointed.
1853.	Metropolitan Gas Light Company started.
1853.	Moonlight schedule abolished (2,300 to 3,833 1-3 hours).
1855.	Harlem Gas Light Company chartered.
1859.	First State Inspector of Gas Meters appointed.
1859.	First City Inspector of Lamps and Gas appointed.
1872.	New York Mutual Gas Light Company started.

1873. Present form of one year contracts for street lighting started.
1874. Part of Bronx Borough annexed to New York City.
1876. Municipal and Knickerbocker Gas Light Companies started.
1877. Naphtha lamps started.
1877. New York City photometric laboratory opened.
1878. Elevated railroads started.
1878. Avenue de L'Opera, Prais, lighted by 32 Jablochkoff arc lamps.
1879. Time table increased to 4,000 hours.
1879. Arc lamps introduced in New York City.
1884. Consolidated Gas Company formed.
1885. Arc lamps introduced in Brooklyn.
1885. Equitable Gas Light Company started to supply street lamps.
1885-6. The Legislature investigated New York City Gas Companies.
1887. Six electric light companies supplying lamps in Manhattan alone.
1889. Regenerative lamps installed upon Lenox Avenue.
1889. Hundreds of electric poles cut down, and nearly 5,000 gas lamps relighted.
1890. Standard Gas Light Company started to supply street lamps.
1894. East River Gas Company's tunnel under East River completed.
1895. Electric incandescent lamps first used in New York City, Wakefield District.
1895. More territory north of the Harlem River annexed.
1896. Mantle gas lamps successfully operated on Broadway.
1898. Mantle naphtha lamps introduced.
1898. Greater New York.
1900. Consolidated Gas Company obtain control of Manhattan and Bronx District Gas Companies.
1902. New Amsterdam Gas Company started to supply street lamps.
1904. Subway opened in New York City.
1905. State Commission of Gas and Electricity appointed after legislative investigation.
1905. Westchester Lighting Company acquired by Consolidated Gas Company.
1907. Public Service Commission Law in effect, beginning July 1.
1907. Tungsten series lamps lighted in the Borough of Queens, L. I.
1908. Tungsten multiple lamps lighted on Riverside Drive, Manhattan.

Historical Notes Respecting the Development of the Last Half Century in the Gas Business of the Pacific Coast

[Prepared by Mr. John A. Britton, Sec. and Treas. Pacific Coast Gas Association.]

Chronological.

1854. San Francisco Gas Co.
1858. Marysville Gas Company.
1860. Portland Gas Company.
1867. Napa Gas Company.
1868. San Jose Gas Company.
1868. Oakland Gas Company.
1869. Stockton Gas Company.

Historical.

California.

Chico: Wooden pipes used in 1852; benches, cast iron, cylindrical, 4″ in diameter, 7′ long.

Oakland: First installation, three iron retorts, gas made from pitch pine; connections 3″.

Napa: First installation, one iron retort, street mains, 3½″ boiler tubes.

San Jose: Started with ten consumers. Coal packed on mules from the most southerly point of San Francisco Bay.

Los Angeles: Gas made from brea and wood, with occasional use of grape pomice. Amount of material used in 24 hours, one-third of a cord of wood and one and one-half tons of brea.

Seattle, Wash.: Original mains were bored logs. First holder tank made of cedar boards and still in existence.

Memorandum.

To properly set forth the history of the gas companies of the Pacific Coast, from 1849 to 1909, would be to write the history of those intrepid Argonauts, who, braving the dangers of field and flood, and attracted by the lure of the golden sands of the Pacific Coast, crossed the arid plains of North America, from Eastern civilization to Western roughness, and plowed their way through the waters of the Atlantic and Pacific to reach the land of gold and the land of sunshine, fruit and flowers. The barriers of the Rocky Mountains and the high Sierras were no insurmountable obstacles to those brave pioneers, and in the golden land of promise, over the fertile valleys of the Sacramento and the San Joaquin, and along the wave-washed shores of the Coast, settlements, like magic, arose almost in a night, and in due time settlements became villages, towns and cities, and the men and women who had come to this new land of promise soon began to feel the necessity for the convenience and comforts which they had left behind them; and, as cities arose and the new civilization became necessary, and when government by the people took the place of the government by the mobs, the institution of gas companies became as much of an essential necessity as provisions for the other necessaries of life. The difficulties encountered by pioneers in the gas industry of the Pacific Coast can hardly be estimated by those engaged in similar industries on the Atlantic seaboard, or, even in the central portions of the Western United States. With the exception of the States of Oregon and Washington, the Pacific Coast contained during those days no known raw material possible to use in the manufacture of gas by methods adopted in the Eastern centers; the coals of California and Nevada, New Mexico and Arizona are of the later periods of coal formation, being lignites or semi-bituminous, and possess no particular value for gas-making purposes. Until long after 1849 the presence of very good qualities of bituminous coals in the States of Oregon and Washington was not known. The prohibitive prices of transportation in the earlier days in the Pacific territories prevented the use of the coals which were imported from either the Eastern States, England or Australia for uses of interior State companies, and while gas coals from Australia were available in the early '50s in San Francisco, the gas makers in the interior settlements were compelled to use wood largely for this purpose, the pine woods of the State yielding a very excellent quality of gas.

Chronologically, and as the natural consequence of its importance in the State, San Francisco was the first city to commence the manufacture of gas. Mr. Wm. Beggs, an engineer of prominence in the Eastern States, was the practical builder of the works of the San Francisco Gas Company, and gas was turned into the mains of that Company February 11, 1854, through approximately 10 miles of pipes. Gas was made from Australian coal, enriched by Australian shale; for what would seem to be now the fabulous price of $15 per thousand. "Pete" Donohoe and Joseph G. Eastland, names revered among the gas men on the Pacific Coast, both of whom are now deceased, were respectively the President and Secretary of that Company. The population of San Francisco in 1854 has been estimated at about 25,000. From this small beginning the city has grown to a population of approximately 450,000, and from 10 miles of mains it has grown to 570, with 66,000 consumers upon its lines, and from a send-out of 25,000 feet per day to a send-out of 15,000,000 feet per day, and from a price of $15 per 1,000 cubic feet to as low as 75 cents per 1,000 cubic feet.

The manufacture of coal gas has, by reason of the cheapness of California oils, given place to what is known as the crude oil water gas process, enlarged, simplified and made successful by the developments of Mr. E. C. Jones, the Chief Gas Engineer of that Company. This gas, in its characteristics, approaches very closely to the well-known coal gas of the Eastern States, as the following analysis will show:

CNH_2N	9.8	O_2	0.2
CH_4	34.0	N	6.8
H_2	40.8	Sp. Gr.	.475
CO	6.0	BTU's	722
CO_2	2.4	CP	24.3

The manufacture of crude oil water gas is, in operation, practically that of carburetted water gas, eliminating only the use of anthracite coal or coke.

The individual history of each company's methods throughout the State, its trials, tribulations, conquest over difficulties and gradual rise from nothing to prosperity would require a volume, and then would emphasize only the pluck of the pioneers in gas manufacture, most of whom have laid down the trials of this world for eternal peace beyond.

Situated thousands of miles in either direction from the centers of population, void of manufactories to supply material, and dependent upon a transportation of from 6 to 14,000 miles, the

earlier gas works of the State were built under conditions that would tax the energies of present time engineers; but the same spirit that built the State to the proud place it occupies in this grand Union of States, like Cæsar of old, "Came, saw and conquered."

The city of Marysville, located on the Sacramento River, below the junction of the Yuba and the Feather rivers, comes second on the list of the operating gas companies of the Pacific Coast. These works were operated first in the year 1858, and have since continuously supplied gas to its inhabitants. Marysville is a town of approximately 5,000 in population, and, while more prosperous and more largely peopled in the earlier days than now, by reason of its then contiguity to large mining interests, it has become at the present time rehabilitated by reason of the fact of the establishment, near the city, of the largest gold dredgers in the world, and the surrounding country contributes to it, largely in agriculture.

The city of Portland, Ore., often referred to by the people of the Pacific Coast as the "Finished City," ranks third in number of the gas companies operating, the works there being started in the year 1860.

The cities of San Jose, Napa, Oakland and Stockton, in the State of California, follow between 1860 and 1867, the works at Napa, Oakland and Stockton having been built from designs of Mr. Wm. Beggs, the designer and originator of the San Francisco Company.

In Los Angeles gas was made from brea and wood, with occasional use of grape pomice; one-third of a cord of wood and 1½ tons of brea were used in 24 hours.

In Marysville, Chico, and San Jose, wooden pipes were largely used as conduits for gas in the earlier days, due to the very heavy expense of cast or wrought iron. These wooden pipes were of various diameters, generally 6 inches in interior diameter. They were not wooden stave pipes, as such are commonly known, but logs of various lengths hollowed out, usually by burning the interior, necessarily making them a very irregular area and capacity. Some of these pipes are still in existence and carrying gas as they did 50 years ago. As stated before, the gas made in all of these cities was either from imported coals or from native woods. These processes have since been entirely abandoned.

As the Pacific Coast has ever been ready to take advantage of any newer or more economical methods, carburetted water gas, made by the Lowe process, was first introduced on the Pacific Coast, in 1877, at the works in San Jose, Oakland, in 1879; in San Francisco and Los Angeles in 1887.

The first successful introduction of crude oil water gas was made in the city of Marysville, under patents of L. P. Lowe and under the direction of Mr. John Martin in the year 1901, these works having a capacity of approximately 5,000 cubic feet per hour; those installed by the San Francisco Gas and Electric Company and the Oakland Gas, Light and Heat Company have a capacity of over 150,000 cubic feet per hour.

Natural gas has been discovered in two places in California, but not in sufficient quantities to render it a factor in supply to consumers, the city of Stockton being the first company to take advantage of the supply of natural gas for commercial purposes. The supply, however, is limited in quantity and does not interfere with the distribution of artificial gas, with which the natural gas is very often mixed. Natural gas also, in limited quantities, has been discovered and is being distributed in the city of Sacramento.

When the snow that caps the rocky wall on our Eastern boundary line was harnessed to the chariot of lightning and made to do man's will, and the invisible power ran over miles of wire, and when myriads of diamond flashing bulbs began to light the way, then the gas men of the Pacific Coast, realizing that electricity was to be a helper and not a disturber of their investments, took up another burden, and that was the burden of the snows. Co-operation with electricity by the gas companies was the salvation of the investments in artificial lighting on the Pacific Coast; to the city of Oakland belongs the credit of having established the first direct-current, arc-lighting station. This was erected in 1882, with the cities of San Jose and Los Angeles a close second.

Independent electric lighting companies are practically unknown in the State of California, but in the Northern States of Oregon and Washington, little or no assimilation has been had between these two factors in the development of the industries of the world; but whether assimilated or not the gas companies and electric companies are making profitable showings of their labors.

The men of the Coast who made history in gas making in the earlier days have all passed away; but we, who knew them during the past third of a century, have reverence for their work and for the monuments they have builded for themselves. The names of Peter Donohoe, Jos. G. Eastland, Wm. Beggs and Joseph B. Crockett are household words among the gas men; and they were gas men in the true sense of the word. Of those who are still in the harness, there occur the names of Chas. E. Burrows, of Walla Walla, Wash.; John Clements, of Red Bluff, Cal.; F. H. Eichbaum, of San Francisco, Cal.; E. C. Jones, of San Francisco, Cal.; W. B. Cline, of Los Angeles, Cal.; C. O. G. Miller, of San Francisco, Cal.; Chas. F. Adams, of Portland, Ore., and Wm. A. Aldrich, of Tacoma, Wash.[1]

From the nipping cold of the North to the blasting sands of the South, from the broad Pacific to the rocky hills of Utah, a territory larger in extent than the combined area of the Eastern and Middle West States, the gas industry has made its mark. The men of it are made up of earnest and active workers, developing, under conditions of high prices of material and due to peculiar conditions of operations under the Constitution of these States, a business that requires tact and shrewdness, requires a study of economics with zeal and a study of the interests of the public by well directed efforts to cheapen the commodity and increase the sphere of its usefulness.

While we of the Western land are relieved from the rigors of the seasons visited upon our Eastern brethren, while we have not to consider the question of the frost land or the matter of the falling of the thermometer below the freezing point, and while we enjoy an equitableness of climate throughout the 12 months of the year, and have a district to control which permits of the use of our commodity to a greater extent than perhaps the Eastern field employs, we have conditions of manufacture and scarcity of materials and vast distances to cover in distribution that are not factors in the Eastern States. All of these conditions have brought about, in California particularly, the matter of distribution of gas under high pressure. California has been the pioneer field in the utilization of higher pressure, the first high-pressure distribution being done in the district of the Oakland Gas, Light and Heat Company, and commencing as early as 1884. There are now many hundreds of miles of high pressure pipes operating under pressures from one pound to 80 pounds per square inch. This method of distribution, and the rapid hourly make of crude oil water gas, have done away largely with the necessity for storage holders, the high pressure pipes being in themselves holders of sufficient capacity to guarantee delivery, and no difficulty has been experienced in deliveries by means of individual governors from high pressure lines, nor any low pressure deliveries from high pressure lines through district governors. It is often the wonder of the Eastern gas engineer to see an out-of-door gas works in California, where the generating apparatuses or purifiers are all out, under the blue dome of heaven, without even the protection of a shack or roof. The photo will give some conception of this strange works.

While we of the West have much to learn from the East, we feel that, in the matter of gas manufacture and distribution, we have much to convey to the East, not only of economy in manufacture and distribution, but also of the increase in the demand for our commodity, and some day the historian of the Pacific Coast will write, for the benefit of the people to come, an interesting history of which the foregoing is too brief an epitome.

The area in square miles of the Pacific Coast States and Territories, namely, California, Oregon, Washington, Arizona, New Mexico, Nevada and Idaho, is 754,670, with a contributing population of approximately 3,500,000. As a contrast thereto, the area of all of the States, lying east of the Mississippi River, with the exception of Florida, aggregates 790,125 square miles. Thirteen States, viz.: Maine, Vermont, New Hampshire, Massachusetts, Connecticut, Rhode Island, New York, New Jersey, Pennsylvania, Maryland, Delaware, Ohio and Indiana, represent only 258,055 square miles, with a population approximating 28,000,000.

In the Pacific Coast States and Territories there are three and nine-tenths people per square mile, while in the 13 Eastern States mentioned there is a population of 108 people per square mile, or

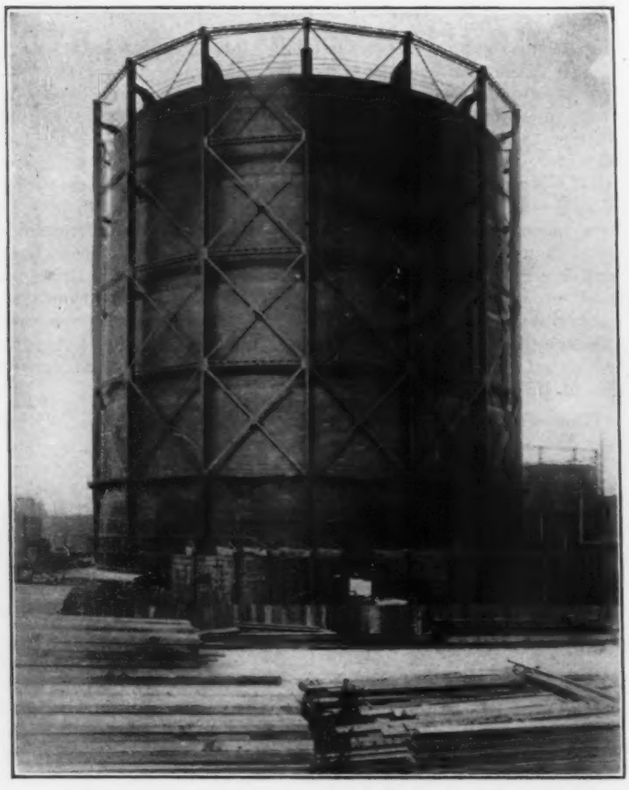
[1]And to these we add the name of John A. Britton, who will live in the gas history of the Coast when and wherever a shred of such history is extant.—T. J. C.

more than 30 times that of the Pacific States and Territories, illustrating forcibly the great potentialities of the Pacific Coast.

In these Pacific States there are 68 operating gas companies, serving a population of approximately 2,000,000 people, or 57 per cent. of the entire population, through 250,000 meters and 3,000 miles of mains, with an annual delivery of 9,000,000,000 cubic feet. This gives an average of 4,500 cubic feet per capita per

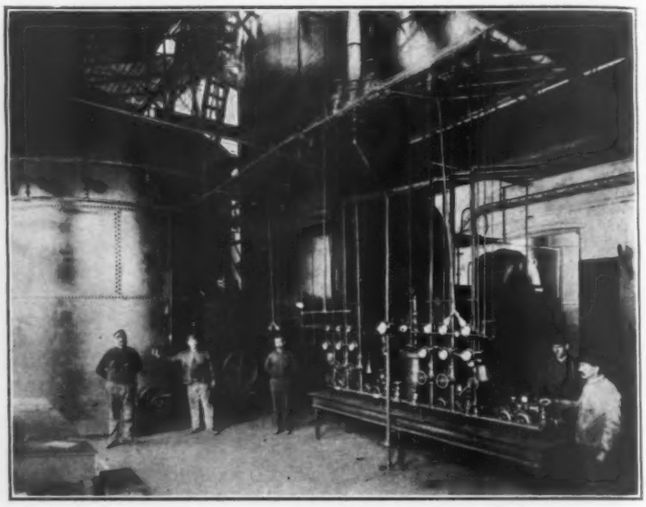
No.1. Out-of-doors Gas Works in Fresno, Calif.

annum. In contrast with this, the 13 Eastern States mentioned, serve a population of approximately 20,000,000, through 2,500,000 meters and 25,000 miles of mains, with an annual delivery of 75,000,000,000 cubic feet, an average of 3,750 cubic feet per capita per annum.



No. 2. 2,000,000 ft. Holders and 30 ft. Wooden Purifiers, Oakland.

The population served in the Eastern States is 66 per cent. of the entire population of said territory. It will be seen from the above that almost 33 1-3 per cent. more gas is sold per capita in the Pacific States than in the congested Eastern centers, perhaps largely due to the fact that fuel for domestic consumption is more easily obtainable and at a cheaper price in the Eastern States. In the State of Massachusetts, operating the same number of companies operated on the Pacific Coast, and having an area of only 8,315 square miles or only 1-3 of 1 per cent. of the area of the Pacific Coast, the annual amount of sales approximates 10,000,000,000 cubic feet per annum; in New Jersey, with only 41 companies and an area of 8,175 square miles, the consumption per annum is less

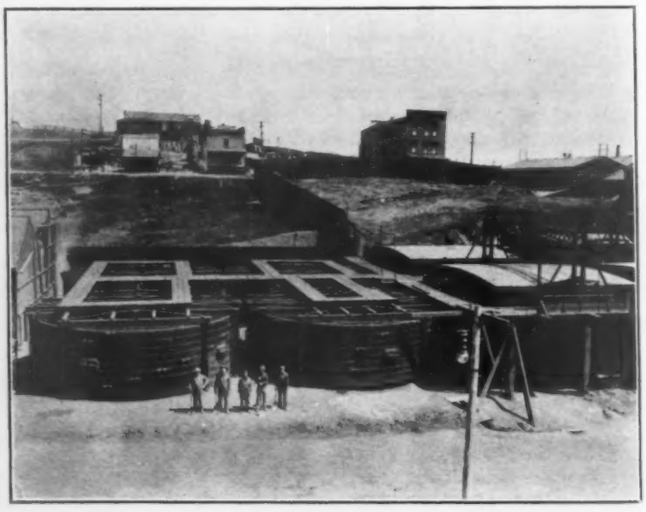


No. 3. Four Million ft. set at Potrero, Calif.

than that of the Pacific Coast States; in the State of New York, having an area of 49,220 square miles, or 2 per cent. of the Pacific Coast, the total consumption approximates 30,000,000,000 cubic feet per annum, or 3 2-3 times that of the Pacific.

The illustrations on this article are typical of conditions on the Coast, and will no doubt arouse the wonder in the minds of most of the Eastern gas men.

No. 1 shows an out-of-door gas works in California, where the generators of the crude oil water gas system are operated without any covering whatever. The operating table of this set, comprising the oil heater and meter, and the centralization of the



No. 4. Illustration of an Installation of Four Wooden Purifiers, 30 ft in Diameter, Installed in the Potrero Station, San Francisco.

valves for the admission of steam and oil, are also out-of-doors, and it is, perhaps, a remarkable fact, but noticeable, that the efficiency of this machine in the matter of number of gallons of oil and pounds of steam used per 1,000 cubic feet is as good as other sets operated within enclosures protected from any changes of temperature.

No. 2 is an illustration of a 2,000,000 cubic feet holder, having at its base four wooden purifiers filled with oxide of iron, and entirely exposed to all changes of temperature and working most effectively.

No. 3 illustrates the type of the Jones crude oil water gas appar-

atus, this set having a capacity of 150,000 cubic feet per hour. This is an hour-to-hour capacity, and during runs of emergency it has made as high as 4,000,000 cubic feet in 24 hours' continuous operation.

No. 4 is an illustration of the installation of four wooden purifiers, 30 feet in diameter, installed in the Potrero district, San Francisco.

No. 5 is a map of the Pacific Coast States and Territories, and by contrast with a similar map (which can easily be made of the Eastern States) will show the vast territories within which there are no gas works, and is typical as showing the congested centers of population.

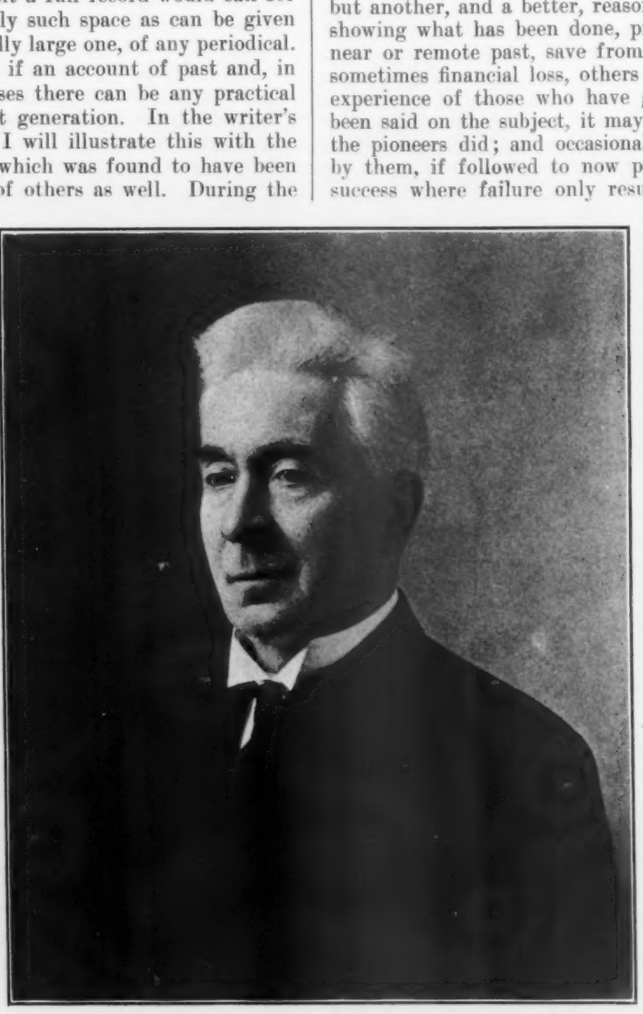
All that the Pacific Coast States and Territories need is the building up by the people, who are bound to be attracted by all of the advantages which it possesses from every standpoint of climate and productiveness. It has long since ceased to be a mere land of gold, and it has now become a land of great commercial promise.

No. 5. Map of Pacific Coast States and Territories showing Cities and Towns having Gas Supply, May, 1909.

Processes I Have Known.

[Prepared by Mr. Frederic Egner, Norfolk, Va.]

That is the subject or title suggested by the Editor of the American Gas Light Journal to the writer as a desirable contribution to the semi-centennial number of this paper. The task set is not an uncongenial one, albeit a full record would call for a good sized tome, rather than only such space as can be given in one number, though an abnormally large one, of any periodical. Let us consider, in the first place, if an account of past and, in many instances, abandoned processes there can be any practical value found of use to the present generation. In the writer's opinion, much in every way; and I will illustrate this with the relation of a personal experience, which was found to have been the same, or like it, in the lives of others as well. During the first two years of the writer's entrance upon the calling of a gas engineer, which was as a machinist and extra steam engineer at the works of one of the New York city companies, now a branch of the great Consolidated Gas Company, he began to improve, as he fondly thought, nearly all the apparatus then employed; beginning with a self-sealing (luted lids only were then used) retort lid, and ending with a retort drawing and charging machine, which, however, never got beyond the first crude model, so far as the writer was concerned. One of the engineers in charge of the old Brooklyn Gas Light Company's works (Mr. George Havens) a little later on reinvented this machine and had it patented; but it never came to anything. The nearest to that invention at this date is an improvement built by Herr C. Eitle, at Suttgart, Germany, and, were it not that horizontal retorts are hopelessly outclassed by the inclined—and yet far more so by the vertical retort—systems, Eitle's "Zwilling," "Schlange," and "Kobold" drawing and retort charging machines would deserve the serious, possibly also favorable, consideration of coal gas manufacturers. Well! Here the writer has unwittingly already interjected one of "the processes," and we must get back to the beginning. After a while the writer became convinced it was fortunate that he had not yet risen above the position of first assistant to his experienced, considerate and beloved Chief. Also, that, had the author been connected with the gas business 50 or more years sooner, he might then indeed have become of some note in the same, for he was pleased to learn that most of his improvements were by no means "new under the sun." But while some had been no doubt for good reasons, scrapped, others had enjoyed a certain degree of success, and were still "in the ring" (as the writer himself is at the present date) as possibilities of promise. Among these very early ideas was the vertical retort. This was condemned, not only by my Chief, but by a number of the leading gas men of that day, because, so it was argued, the coal would swell during the coking process and burst the retorts; or else would get so tightly bound in the retort that it would be impossible to get it out. And, besides, how could the gas leave the retort? This was provided for by Mr. Chas. F. Dieterich, who is still among the living, "may his shadow never grow less," by devising a vertical retort, which had numerous outlets along and up its vertical sides. This design was never tried, probably because Mr. Dieterich became interested in the carbide of calcium business, in which he is reputed to have amased a colossal fortune, in the enjoyment of which he has certainly the good-will of all who had the honor or pleasure to be associated with him in his former professional calling. And so we have accounted for another "process," but which, despite its earlier handicaps, is now a sure winner, as many a reader of this article knows. That is one good reason why an account of now mostly forgotten processes may, after all, posses a practical value for the beginners of to-day; but another, and a better, reason perhaps is this, that it will, by showing what has been done, promised, or accomplished, in the near or remote past, save from error, disappointment, and also sometimes financial loss, others who are willing to profit by the experience of those who have gone before. Yet, after all has been said on the subject, it may be worth while to consider what the pioneers did; and occasionally some of the paths blazed out by them, if followed to now possible conclusions, may lead to success where failure only resulted before. Permit the writer once more, in connection with the above, to quote the inclined and vertical retort systems, not forgetting the water gas process, as being neither last nor least, which in its inception is older than most gas men of to-day think. But, after all, its practical success became assured *only* after the popular discovery of crude petroleum, of which more later on.



To my Friends—
Sincerely Always
Frederic Egner.

From 1797, when lighting by gas became an accomplished fact, through the inventions of Mr. William Murdoch, and under his direction, until about 1872, when petroleum was introduced as a valuable factor, processes were few. Our knowledge of such is confined to the improvements made by Samuel Clegg, Dr. Henry (William), John Malam, Samuel Crosley, Laming, Melville; Cathels, Sir George Livesey, and many others well worthy of mention, but whose names must be omitted in the present article. Clegg was the inventor of the hydraulic main, purifiers and wet meter, which are in use to this day; and he proposed and experimented with a number of other improvements, which the reader will find mentioned in "King's Treatise on the Manufacture of Coal Gas."

As most of the inventions and processes made and introduced by the Past-masters in the Craft are well known to students of the art, the writer will confine himself to a few of those not so well known.

A New England man was granted a patent for a process, in which a vertical retort, fed by powdered coal at the top, and from which the resultant coke was to be removed at the bottom, was the principal feature. The idea was that, when coal was fed into a highly heated retort in a finely powdered state, the coal would "flash" into gas almost instantaneously, and whatever did get to the bottom would be only thoroughly exhausted solid carbon. Twenty thousand cubic feet or more, of high quality illuminating gas, was predicted by the inventor. The writer regrets not at this moment to remember the name of that genius, for he nearly was put past the ability to regret anything by having given the process a private trial, at his own expense, at the works of the Laclede Gas Light Company, St. Louis, Mo., in the year 1885. It is not known to the author if anybody else ever tried that "process," but he would suggest that, if any reader of this Journal is disposed to make the attempt, he had better be very careful. For the coal will flash, just as the inventor claimed; and that is about all the writer can say about it of his own knowledge as to results. Another coal gas process was the invention of Mr. Darius Davidson. It consisted

of a "double-deck," horizontal retort, having a passage at the back end, between the upper and lower chambers, into which said retort was divided. The claim made, and fully substantiated, too, by the inventor was that, whereas in the ordinary retort the yield of gas from good coal was (at that early date) only from 4 to 4½ cubic feet of gas per pound of coal, with his method it would be increased to from 5½ to over 6 cubic feet. The writer was detailed by the president of his company (the then "Metropolitan" of the City of New York) to investigate the subject.

It was found that, while the results obtained in the Davidson retort were as claimed by the inventor, the apparatus would be not suitable, at any rate for large gas works, because the height of the retorts was such that, with our then means of drawing and charging, not more than 3—at most 4—retorts could be set into one oven or bench. Besides, were we to reduce the weight of charges per retort (300 to 350 pounds of coal per 4 hours) and pay more attention to the heats, we would get pretty close to the Davidson results in our ordinary 14″ by 22″ by 9′ retorts. Accordingly, the charges were reduced as recommended, and we were soon getting 5½ cubic feet of gas per pound of coal; also, pitch enough in the hydraulic main to almost shut down the works for a little while. Afterward we struck the happy medium, which has been the practice of successful coal gas makers ever since. Another "process" was in the shape of a revolving retort, for which the writer was granted a patent 'way back in 1882. It was also an "inclined" retort, but never got beyond the pictorial and descriptive stage in this country; but it afforded the author quite a surprise, 15 years later, to find 3 or 4 of the machines erected at the works of the Belfast (Ireland) Corporation Works, but where, if not misinformed, they were never operated because of the failure eventually of a similar apparatus at an English gas plant. Upon the authority of the late Chief Engineer, James W. King, U. S. N., the writer may state, that "a trial to burn water" was subjected to a test at the Brooklyn, N. Y., Navy Yard about 1852-3, that resulted in a practical failure. Uncarburetted water gas was produced and consumed, and the result, while described as interesting, is classified by the Investigating Board as "properly ranking with perpetual motions"; but, with the advent of petroleum, "processes" began to spring up in many places, and of these we will now review several of the most "promising" ones. First came the "all oil" gas; then "oil and coal" gas; "oil and air"; "oil and hydrogen"; and nearly about the same time carburetted water gas made its appearance.

The first patent issued for a gas apparatus in this country was that granted to David Melville, of Newport, R. I., March 18, 1813; since which time more than 3,000 patents have been allowed by the U. S. Patent Office alone, nearly all of which have been at one time or another examined by the writer; and if the reader will consider that nearly all of the methods named above are represented by hundreds of patents, it will be seen why many, and even some very interesting, "processes" cannot be mentioned in this article. Coal gas, whether produced in horizontal retorts, with manual or mechanical stoking, inclined or vertical retort systems, or water gas as produced by the standard improved "Lowe," or derivations thereof, need not be described herein. The technical reader is familiar with all these, while included in "The Processes, etc., etc."

But an extract from an editorial published in "The Scientific American," of October 21, 1876, is likely to be interesting reading at this time. As subsequent events have demonstrated, it *was* prophetic. Here it is: "The long effort to obtain the gases of water upon a practical scale, that is, in unlimited quantity and at an economical cost, is too old and familiar a story to need repetition here. It has covered many unsuccessful attempts, and so many misrepresentations, that the very name has been a synonym for failure and fraud. Nevertheless, it is to-day an accomplished fact, as real as the systems of steam power and telegraphy; and it is peculiarly gratifying that, after 65 years of unsuccessful experiments, in which the most enlightened nations have participated, our Centennial year should witness the complete demonstration, by one of our own countrymen, of a method, the value and influence of which, on the industries of this industrious age, can hardly be estimated. This 'Journal' has heretofore directed attention to the earliest performances of the new method, which has now accepted and accomplished a test upon so large a working scale as to entitle it to marked recognition. It would really seem that the question which has been so prominently before the public of late, as to the possibility of obtaining better and more economical methods of lighting, has been fully met and answered by this system."

"It certainly furnishes a very brilliant illuminant at what is claimed to be an important reduction in cost, and it is hoped that those who control the gas making interest will give prompt attention to the matter. Their business has grown to be one of the great industries of the period, and it should be conducted upon progressive principles. But valuable as this process may be for illuminating purposes, it must be manifest that a demonstrated success in this department carries with it some great possibilities in the direction of fuel. There is scarcely a question of greater practical interest than that relating to improved methods of heating, as it affects so wide a range of manufactures in metallurgy, mechanics and chemistry, to say nothing of the still wider realm of domestic uses. Our present systems are still grossly defective and wasteful, utilizing not more than one-eighth of the heating power of coal, without reckoning the inconvenience and cost of handling so heavy a material. It is hardly unsafe to predict that the coming fuel, for the next stage of swiftly developing civilization, will be in a gaseous form, the advantages of which are too apparent to need enumeration. The field of investigation presented by the Lowe process is one of great interest and should be improved." A history of the evolution of water gas, from the beginning to its triumphant enthronement in a majority of the gas works of the world, would alone furnish interesting and entertaining material for more than one good sized volume. Were the various and only successful systems intelligently described, it would also supply much instructive matter; for we would not only have the so generally adopted "Lowe" system and its improvements, but several not by any means to-be-despised competitors at one time, to deal with. There was the "Rew" process, the "Springer," "Hanlon and Leadley," the Jerzmanowski," and the "Loomis," the latter being built upon the fundamental of all suction gas producers, which was the invention of the writer, and upon which several patents had been issued prior to the date of the filing of the first Loomis claim. These all differed considerably from the original "Lowe" apparatus. Then there came a number of "processes" which all were more or less modifications of the original "Lowe" process; and we shall try to glance at them in passing. We cannot do more at this time. Of the strictly oil gas processes, the "Rand" was the best known and most widely used, if we except the "Pintsch process," which, along with the "Edgerton" oil and some other "processes" was controlled by "The Safety Car Heating and Lighting Co.," of New York. The superiority for car lighting of the Pintsch system was set forth by the company just named, partly, as follows: "For car illumination it costs not more than one-third as much as kerosene per hour; is as safe as kerosene is dangerous; and is the most brilliant and satisfactory light ever applied to cars."

That, and its associate systems, were employed by the U. S. Government for buoys, beacons, lightships, lighthouses and stake lights.

But its use was not confined to these. Depots, factories and villages were thus lighted, and when the company named approached the Laclede Gas Light Company, in 1888, with a proposal to erect one of its plants at St. Louis, the writer, in the absence of the president of the company (Mr. Emerson McMillin) in Europe, was instrumental in the Pintsch system being installed, for car lighting purposes, at one of our stations. He was induced to that course by the apprehension that, unless such course was adopted, the oil gas people would come in anyway, and we would then have another competitor to deal with. Our president (being in Europe, as just stated, at the time) with some reluctance consented to the arrangement, which since has become a very valuable asset of the "Laclede"; and the "gassing" of cars has grown from the earlier 12 to 16 cars per day, to several hundred.

The method of manufacturing oil gas is so simple that we will not encumber these pages with a detailed description, only adding that, whereas formerly cast iron retorts were deemed imperative for the best results in oil-for-gas carbonization, fireclay retorts having been found equally efficacious and much less costly, were installed at the Laclede works at any rate. Almost simultaneously with the straight oil gas processes arose many air and oil gas machines, as well as enrichment of coal gas with oil instead of cannels. Hundreds of patents have been granted for the former method of producing an illuminant, although the difference between many of these processes is only apparent to a Patent Office Official, not being discernible to a plain, everyday gas man.

There was a time, and it was in the early '70s, when the light oils resulting from the distillation of petroleum were not only a valueless but also an extremely dangerous by-product of the manufacture of kerosene for domestic use. It was only due to the much, and both unfairly and unjustly maligned "Standard

Oil Company," that this condition was changed for the greater safety of the public at any rate, while resulting in greater cost of material to gas companies.

Prior to the organization of the company named, many of the illuminating oil producers, finding no outlet for the light oils, would use at least some portion of these to increase their "kerosene" output, thereby causing innumerable lamp explosions, and the horrible deaths of the victims. At that time we could get so-called naphtha by paying little more than the cost of freight from the oil fields, as the producers were anxious to get rid of it. Accordingly, there was installed, at the works of the Metropolitan Gas Light Company, of New York city, a process for enriching coal gas, which was very successful.

That process was described in the AMERICAN GAS LIGHT JOURNAL, and can be found on page 156, Vol. 33, issue of October 2, 1880; and, again, in the same JOURNAL, page 363, Vol. 45, December 16, 1886. A couple of years later, this method, somewhat modified, was "adopted" by one "Meeze," who called it *his* process, and endeavored to improve his bank account therewith; but in which he was not very successful. It was used under that name at one of the Brooklyn (N. Y.) gas works,[1] conducted then under the supervision of that prince of good fellows, the lamented Captain William Henry White, who demonstrated it sufficiently well to keep it in operation for several years, but to be abandoned at last when the price of oil went up beyond the give-away stage. It may be taken for granted, however, that the naphtha of those days at the then prevailing price and more, or crude petroleum at the present prices, is a cheaper enricher of coal gas up to a limited candle power, and when used as described by the writer in the publications named, than cannel ever was or is to-day. As abnormally high candle power is not as popular as it once was, and for good, solid reasons, too, the above facts may have more than an archæologic interest for the reader of this date.

We will now pass on to the retort coal and water gas processes as closely related to the preceding class.

Among these the Allen-Harris Process easily led as a matter of fact, though from an intimate acquaintance with it on part of the writer he cannot endorse the following: "The Allen-Harris Process with new and Improved Apparatus for the Manufacture of the Purest and Cheapest Fuel Gas, the Best Illuminating Water Gas, and the Most Perfect Chemical and Scientific System for Carbonizing Coals, in Connection with Oil and Water Gas." The above is from the title page of a pamphlet published in 1892 by the late Mr. A. L. Allen, who was personally one of the most lovable men the writer has known, but whose exalted opinion of the merits of the process were not borne out by the results obtained in the course of a thorough trial upon a full working scale at the works of the Norfolk City Gas Light Company, Norfolk, Virginia, 1882, then under the supervision of the writer. The process was well recommended by a number of prominent scientists, among whom we still have with us, Prof. Chandler, of Columbia College, New York; while others, no less noted and known, have passed over to the Silence, though their memory is cherished and respected by those who knew them in their time and day. A study of the Allen-Harris publications would be no waste of time by the reader even now; but for obvious reasons we cannot reproduce them here.

The trial of the process named above resulted in its being displaced by the once well-known "Granger" process; and that, later on, by the "Improved Lowe," supplied by the United Gas Improvement Company, which again was superseded by a modification of the former furnished by Messrs. Humphreys & Glasgow. This is no doubt a full explanation in itself, without going further into the merits of either of the processes or apparatuses mentioned. Other "Processes that I have known" included the "Springer"—improved by the writer at the invitation of the late A. M. Billings, of Chicago (during the spring and summer of 1883), which improvement was later on described and illustrated in the March 25, 1889, number (Vol. 50) of this JOURNAL, the apparatus itself having continued in operation for about four years after it was completed. This design or improvement of the original "Springer" process was imitated by a number of "Inventors" who were not particular about giving "credit" of course.

Having been actively engaged in the gas industry for a period of 37 years, several of which were spent in traveling throughout the United States and abroad, it scarce could be otherwise than that nearly all of the legitimate and not a few of the *fraudulent* processes should have come under the observation of the writer, and want of time, as well as consideration of space on this occasion, warn the author that he must content himself, and possibly ask the reader's indulgence if he reviews some of the processes only by their title, though they are worthy of more notice. Before me are four finely illustrated and well-written pamphlets and several leaflets describing the Henry C. Rew "Process," which apparatus the writer had the pleasure to inspect the last time in company with Mr. Forest E. Barker, Chairman of the Board of Gas and Electric Light Commissioners of the Commonwealth of Massachusetts, during the Columbian Exposition period at Chicago, Ill. The process and apparatus were greatly improved from what they had been in 1887, when first brought to the writer's notice, and were creditable to the designer, who, with original inventive genius, combined a ready appreciation of good ideas of others as applicable to "his own particular baby," which thrived well for a number of years.

Then there was the "Tessie Du Motay" process, which flourished for some years at one[2] of the New York City (and other) works; the "Wilkinson Process," operated at the New York Mutual gas works, where it displaced a wood and oil gas process, probably the Wilkinson. It is still in operation at one of the Washington (D. C.) works, or was until quite recently. The "Jerzmanowski" (which may be more fully described some other time), and the "Flannery," both of which have been operated upon a large scale and for a number of years at New York City, and other works, showing their fitness to survive for a time at least. The "Moses" apparatus, which was a sort of combination of the "Granger" and "Hanlon-Leadly" process. The "Granger-Collins" process, in which was first shown the double superheater now a feature of the "Improved Lowe." The "Martin," a clear infringement of the original "Lowe" process; and the "McKay-Critchlow"; "Pratt-Ryan"; "Peter English"; and the "Fitch" process; which aimed to do the same thing done by the improved "Springer" process, without calling it by that name. There were one or two others whose patronymic (by adoption) the writer does not at this moment recall. The "Enterprise Gas Apparatus," or "Bujac" process, was another of the "Lowe" imitators, as was the fine apparatus, constructed by the Economical Gas Apparatus Company of Toronto, Canada. The "Rose-Hastings" process, as the writer saw it at Westchester, Pa., was in operation not very unlike the "Rew," but on paper and illustration it combined several other not unfamiliar (to the writer) features. This "process" laid claim to manufacturing water gas direct from gas coals, steam and oil; but, in fact, it was operated by using gas retort and oven coke when seen by the author; and not much to brag of then, as to results. It was advertised by means, among others, of a well-gotten-up pamphlet, with fine illustrations showing exactly how that apparatus *was not;* and boasting of a sheet of analyses signed by the New York Gas Inspector (then) Mr. E. G. Love. The "Miller Reversible Zig-Zag System" shows a remarkably plausible appearing apparatus, in which coal is carbonized in vertical retorts, set close to and above a plain water gas generator, into which the coke produced is assumed to drop by means of suitable chutes, red-hot and direct; thus saving heat units and labor, provided it will operate as described and hoped for by the inventor and promoters of Pittsburgh, Pa.

A somewhat similar idea was carried out, but failed at one of the Brooklyn (N. Y.) gas works, the inventor being Mr. Pierson, a brother of the first General Superintendent of the United Gas Improvement Company. Mr. Pierson's apparatus employed inclined instead of vertical retorts, and certainly did not look as if it could fail; but it did. Mr. Walton Clark and Rollin Norris, both of the U. G. I. Company, had something on the same order, but the writer is not informed if it was ever tried in practice. It did look well on paper, however, as did an apparatus designed by the writer at Chicago, in 1883, and which was afterwards described and illustrated in the "Scientific American" in July, 1883, and in the AMERICAN GAS LIGHT JOURNAL, March 2, 1887, Vol. 46, page 145.

The "McKenzie Process" was tried out at Norfolk, Va., in 1875-6, where it was not successful. It was improved afterward by the inventor, who was also the inventor of the well-known exhauster of that name, and operated for several years at Astoria, N. Y. It was a generator and retort process; as was the "Egner," operated successfully for some years at St. Louis, Mo. This last was also the first real "Suction Gas" process known, and which system is now so widely employed with gas producer engine plants. The name of "Edgerton" has been previously mentioned with reference to an oil gas process, but the same gentleman was also the inventor of a water gas process of the order named, and which was operated at several plants, notably at New Orleans, La.

And there was the "Salisbury," the "Harkness" and the "Strong" processes; the "Evans" and "Van Steenbergh," among others which

[1] The Citizens' Gas Light Co.—EDS.

[2] Municipal and Knickerbocker Gas Cos., 1878.

were actually operated; and a host of such as were only "proposed," among them an ingenious one by C. H. Rider, of St. Louis, Mo., for manufacturing fuel gas from limestone and charcoal or coke. Another set of processes, at one time not popular, but by reason of the discoveries of immense deposits of petroleum on the Pacific coast being used to local advantage, are the "only-oil-and-steam" water gas devices of which the "Kendal Process" was about the first, and the "Van Syckel" a good second. The former was investigated by the writer, while in operation at a small city in Illinois, and was found to produce a fair 16 to 17 candle-power gas with an expenditure of 12½ gallons of crude oil; no other fuel being used. The generator and carburetter consisted of a vessel of the usual form, filled with checkerbrick. These were highly heated by suitably located oil burners, and when the brick became hot enough, the air going in with the oil was shut off, and steam turned on instead, with a reduced oil jet, and with the result just mentioned. It was very simple indeed, and only the large quantity of oil required was in the way of its more extended use at that time. The Van Syckel apparatus was quite different in shape, but similar in principle of operation.

A number of apparatus working upon the same principle have been patented, but the "Kendal" appeared the best to the writer. By the way, the inventor of that process was not a gas, but a railroad man.

Producer gas processes and apparatus almost without number have come under the observation of the writer, and while these may not seem to have any special interest for the illuminating and domestic fuel gas man, he may change his opinion on reading the following, should the same have not already come to his notice in a somewhat more disagreeable way, which is a possibility with some and a fact with other readers of this JOURNAL.

"The only successful Soft Coal Gas Producer on the market."

"Requires little or no attention during idleness."

"Less heat energy wasted than with any process known."

"Less labor in producing gas."

"Our process makes the purest engine gas that has ever been produced."

"Our gas is drawn off before it reaches the top of the fuel column, therefore no impure gas is allowed to escape from the generator. Because of the above reason there is no necessity for an elaborate purification system as in other producers."

"Our gas contains more heat units than any producer gas made."

"With the Parker producer there is no biproduct recovery. The reason why we have no biproduct recovery is because the impurities are drawn off from the top of the fuel column and consumed by re-entering at the base of the fuel column, thereby utilizing all their heat energy."

"The only successful illuminating gas that has ever been manufactured from Producer Gas."

"A few reasons why Parker Producer Gas should be used for Domestic Purposes":

"(1.) The wife always in good humor."

"(2.) Everybody likes to cook with gas. It pays to cook with gas."

"(3.) You can cook with gas and save 50 per cent. of your expense. The Parker Gas Producer furnishes gas that beats all others for domestic purposes. Cheap, clean, pure, no danger."

The above extract is copied from a leaflet sent out by the promoting company, upon another of which there appears an analytical report made by a "Consulting Engineer," of Lincoln, Neb., who states that the said producer gas "Showed a calorific value of 181 British Thermal Units per cubic foot, which value is very much higher than usually obtained; but, allowing a very large margin for errors that may have crept in, due to the small number of tests and the lack of a more suitable laboratory, it would still leave the heating quality of the gas far ahead of the average producer gas." Which is no doubt true, and there is more of the same tenor in the report of that expert.

Another leaflet accompanying the very elaborate prospectus and description of the said producer, shows several pictures of the usually accepted "Uncle Sam," with the further announcement, "Uncle Sam says officially"—"Gas light at one-fourth the cost of electric light."

In appearance, according to the illustrations and description by the promoting company, this producer differs not at all from a number of other, though much older, producers; while the chief distinctive feature named by them was shown in a patent granted to the writer of these lines in the year 1885. The "inventor of our producer has had over 30 years' experience in the manufacturing of gas. He is pronounced by the fraternity to be one of the best men there is in the business to-day." We believe that this statement may be news to at least some of "the fraternity," and we may further say that the publication from which the above is taken is not an old one, but is of almost to-day. There is further relief in sight for the general public, if not for stockholders of gas companies; for, in addition to the remarkable producer just noticed, we read in a New York daily of recent date, that one of the noted Astor family has turned inventor, having invented a gas process in which peat, hithertofore useless for gas making, owing to its containing so much water, and of which there exist almost unlimited quantities, is successfully converted into useful gas. The inventor, however, does not want to profit by his invention materially, but, after he has thoroughly tried it out upon one of his estates, he is going to present his invention to the American people. The writer regrets his inability to give more information upon the subject mentioned, but a few words about another wonderful peat process, which he was invited to inspect and report upon, may not be amiss at this time.

This process was the invention of Mr. William H. Browne; the time, May, 1896; and the place, the grounds of the Cambridge (Mass.) Gas Light Company. The process was thus described: "First Process—The production of both illuminating and fuel gas from crude petroleum and water. Second Process—The production of illuminating and fuel gas by passing the gas produced in the first operation through peat brought to a state of incandescence." I shall not now describe the apparatus, more than to say that it was well designed and put up, and that the supposed steps in the production of gas, from an emulsion of 5 or 6 volumes of oil and 95 or 94 volumes of water, are quite interesting, but too long to repeat here. There was also a steam pump of novel construction, the invention of the same Mr. Browne, by means of which the proportions of oil and water pumped into the apparatus could be regulated to a nicety and at will. There could be no doubt of *that* part of it. Concerning that process, Prof. Henry A. Mott, Ph.D., LL.D., "Chemist and Engineer," submitted the following "Opinion": "From the fact that the total petroleum utilized is completely converted into gas by this process, when by other processes from 10 to 15 per cent. is left in the condition of coke or of condensed hydrocarbons, and from the fact that the Browne Process is the first to utilize peat in connection with oil in the manufacture of illuminating and fuel gas, I am clearly of the opinion, as a result of my investigation, that the Browne process is the most economical method for the manufacture of gas known." The above is dated "New York, September 9, 1895."

The writer had gone at his own expense but by invitation of Mr. Browne, to Boston, to look over that process in company with a selected party, of whom were the Professor, several newspaper men, merchants and capitalists. We looked over the plant, we thought carefully; but somehow the writer was not quite satisfied, so early in the morning, long before six o'clock, he went to the Cambridge works to make a little quiet investigation just by himself. And he will confess even now that he was sorry when he found his doubts as to the genuineness of the whole process, excepting the pump, were only too well grounded. He could ill afford, at that time, the expense of such a trip, not to mention the promised fee and other desirable contingent emoluments; he was very sorry for Mr. Browne, who was not a rich man, but a real genius; and he felt sorry, too, for the others who must be disappointed in their expectations eventually. But he made straight for the gate, intending to take the first train out of Boston back to New York without seeing anybody else again, in connection with that process. To his surprise, on going out he met Mr. Horace A. Allyn, the Superintendent of the company, an old acquaintance and a sincere friend, whose habit it was to go to his works before breakfast, to see things started right. To him the writer confided his findings, causing a hearty laugh on part of Mr. Allyn, who then enlightened the writer as to a few more "points" connected with the process. And that ended it.

Among the "fake" processes which have come to the knowledge of the writer was the one time notorious "Harris Process." Primarily the apparatus upon which that "process" was based was the invention of Mr. Elmer B. Knight, who, while engaged at Norfolk, Va., in demonstrating the then newly erected Granger apparatus (1882), showed the writer his idea of an improvement in water gas apparatus, and asked his opinion; which in view of what had by that time been seen of the "Lowe" and like processes, was not favorable. Mr. Knight decided not to go to the expense of applying for a patent; but in order to secure at least the credit of his idea, he sent a description and drawings to a since defunct periodical in which the same was published. It was nearly 10 years later when the "Harris Process" made its appearance; and, under

the ægis of a former Treasurer of the United States, and other influential backing, succeeded in separating many people from their cash, including in the victims men of the highest respectability, down to a poor Cincinnati washerwoman, who lost her little all in the venture, as the late General Andrew Hickenlooper assured the writer.

The method employed by the originator of that "process" has been closely imitated by the promoters of another "process" previously mentioned in this article, but of much later date; and was itself an imitation of still another "process," called by its inventor and promoters "The Solar Light Process," and a few years later "The Imperial Gas Process." Upon the cover page of the gaudily illuminated descriptive pamphlet in possession of the writer he has registered the following: "This is a FRAUD of a Process. It was operated and *exposed* and *killed* at the Laclede Gas Works in 1885." The illustrations and devices with which said pamphlet is richly embellished would make a curious sight in the columns of the JOURNAL, but would be of no use, unless to show to what extent industrial freebooters will go to capture their desired prey. The writer feels somewhat tempted to tell the story of that "process" and its subsequent derivatives, along with the really sad results to a few of its victims, and the very serious lesson to officers of gas companies, *never* under the most specious promises to permit even at the expense of the promoters, such a process to be as much as tried, upon their premises.

Another lesson capitalists and gas companies without exception might well and profitably to themselves take to heart, is that the advice or opinion of an experienced, disinterested consulting engineer is as a rule a good investment, so considered abroad; but neglected in this country as a general thing. There are still several "processes" which the writer might mention. For instance, how Lima crude oil was first introduced in gas making, but which the student will find recorded on page 295, of the May 2 (Vol. 48) number of this JOURNAL; the Byron S. Sloper "Automatic Gas Process"; the "Claus Process," and others. But trusting this article will be acceptable to the readers of the JOURNAL, and that they will not think it too long, and no one will think he has been overlooked on purpose, we will now close down the lid on "Processes I Have Known."

Fifty Years' Progress in the Gas Industry in Canada.

[Prepared by MR. WILLIAM H. PEARSON, General Manager Consumers' Gas Company, Toronto, Ont.]

Although only asked to write an article on 50 years' progress in the gas industry in Canada, having the information available, the writer thought it would be interesting to go back to an earlier date.

Prior to 1842, the tallow candle was almost the only artificial means of illumination in Canada. Sperm and wax candles and oil lamps were luxuries indulged in by the few. Although the company at present supplying Montreal with gas has no records of the fact, it is evident, from data in the possession of the Consumers' Gas Company, of Toronto, that the first place in Canada in which gas was introduced was the City of Montreal, and that it was supplied from works owned and operated by the late Mr. Albert Furniss, a short time prior to 1842. The citizens becoming dissatisfied with the price charged, and the quality of the gas, some time prior to 1847, a company under the name of "The New City Gas Company," in Montreal, obtained a charter, and subsequently purchased the works of Mr. Furniss.

From his long connection with the Consumers' Gas Company, of Toronto, the writer is in a position to give more information regarding it than he has been able to obtain from other companies, which must be his excuse for referring to it to so great an extent.

Gas was first supplied in Toronto, in 1842, by the same energetic and enterprising citizen who introduced it in Montreal (Mr. Furniss), under the name of "The City of Toronto Gas Light and Water Company." The writer well remembers, when a small boy, jumping over the trenches where the pipes were being laid, in 1841. Much dissatisfaction having been expressed on account of the high price ($5 per 1000), and the poor quality of the gas, on the 17th of September, 1847, "A meeting of gaslight consumers and other inhabitants of the city was called to consider the propriety of establishing a new gaslight company," and subsequently it was resolved to form a company to be called "The Consumers' Gas Company." The following extract from the report of the committee to obtain subscribers will give some idea of the general feeling of dissatisfaction which existed. In referring to the necessity of the formation of the new company, the report says: "It is generally admitted to be absolutely necessary, for the accommodation of the citizens, so as to ensure them a constant supply of wholesome gas at a reasonable price, and thus relieve them from being dependent, as at present, on a very uncertain supply of a very impure article at a most extortionate price."

It might here be interesting to state that one of the original promoters, Mr. Thomas Paterson, is still in the land of the living, is well and hearty, and in full possession of his faculties, at the age of 93. As far as the writer can remember, he is the only one remaining.

In one of the reports of the committee, they express their confidence that "Within a few short months it (the city) will enjoy at 10 shillings currency ($2) per 1000 cubic feet, instead of 25 shillings ($5) now charged, a gas light as pure and brilliant as to be met with in the United Kingdom." Unfortunately this anticipation was not realized until 1877, the price up to the fourth year of the company's operations being $4, and for several years after $3.33 1-3 per 1000, in addition to meter rental.

The idea of the promoters, as embodied in the minutes, was to limit the number of shares of each stockholder to 10 shares of $50 each, and it was "deemed more expedient to adhere to the above limit and give the preference to consumers, which so strengthens the foundation of the institute, as to render all opposition nugatory; in short, its character is that of a mutual company wherein all consumers participate in the surplus profits, the directors being required to make an abatement in price to the consumers from time to time, according to the Act of Incorporation."

On the 29th of October, 1847, a general meeting of the subscribers was held, and a Board of 12 Directors appointed, Mr. Charles Berczy, the then Postmaster, being elected President, and Mr. John Watson Secretary.

On the 22d of March the company obtained an Act of Incorporation, with an authorized capital of £50,000 currency ($200,000) the dividends being limited to 10 per cent. per annum.

Subsequently negotiations were entered into with Mr. Furniss for the purchase of the works of "The City of Toronto Gas Light and Water Company," which purchase was consummated the month of June, 1848, the amount of purchase money being £22,000, or $88,000.

Hitherto gas had been supplied both by meter and by flat-rate contract, which arrangement was continued for some time. It is somewhat amusing to read the stipulations laid down when gas was supplied by contract: "Lighting must not commence on any day until the sun has set, and all lights must be extinguished each night within 10 minutes after the hour contracted for. If otherwise, they will be held as used for an additional hour each night and for the quarter charged accordingly. In like manner if the flame is allowed to burn higher than stipulated, a corresponding price will be charged, and if on any occasion more burners or jets are used than contracted for, the additional number will not only be charged, but the offender will besides subject himself to the penalty provided by the statute." It is hard to say how these conditions could be enforced. Somewhat similar conditions prevailed in Montreal, where, in addition, a discount was allowed from the prices charged to shareholders of the company, ranging from 6 per cent. on owners of 1 to 5 shares, to 25 per cent. on holders of 100 shares, the price of gas per 1000 being 12/6s ($2.50) with no meter charges to parties consuming £6 ($24) and over per annum.

The only burners used at this time, and for many years after, were fishtail or lapwing metal ones. The gas seldom being above 12 candles, and containing to the writer's recollection a very large quantity of sulphuretted hydrogen, was not much of an improvement upon that supplied by the former company, though the light was considerably better than that of tallow candles. Only iron retorts were used, and no exhausters, clay retorts and exhausters not being introduced until a very considerable time after.

The output of gas for the first year of Mr. Furniss's regime was 1,146,000 cubic feet, and that of the Consumers' Gas Company for the 15 months, ending 30th of September, 1849, 5,774,000 cubic feet, being about equal to the company's average daily output for the past year.

The works purchased from Mr. Furniss were limited in extent, and of a very crude nature. In 1855 the company erected complete, new works on another property (of which I enclose a photograph of a print of the front elevation). The following modest statement is an extract from the directors' report of that year: "These works are considered by all who have examined them

to be equal, if not superior, to any on this continent, and are capable of still further extension when required, the plan of the works having been laid out with a view of supplying a population of over 100,000."

In 1887-1888, the year of the visit of the American Gas Light Association, the company erected another complete set of works, containing modern improvements, including benches of full-depth regenerative furnaces, and charging and discharging machines. Subsequently a complete coal and coke conveying system

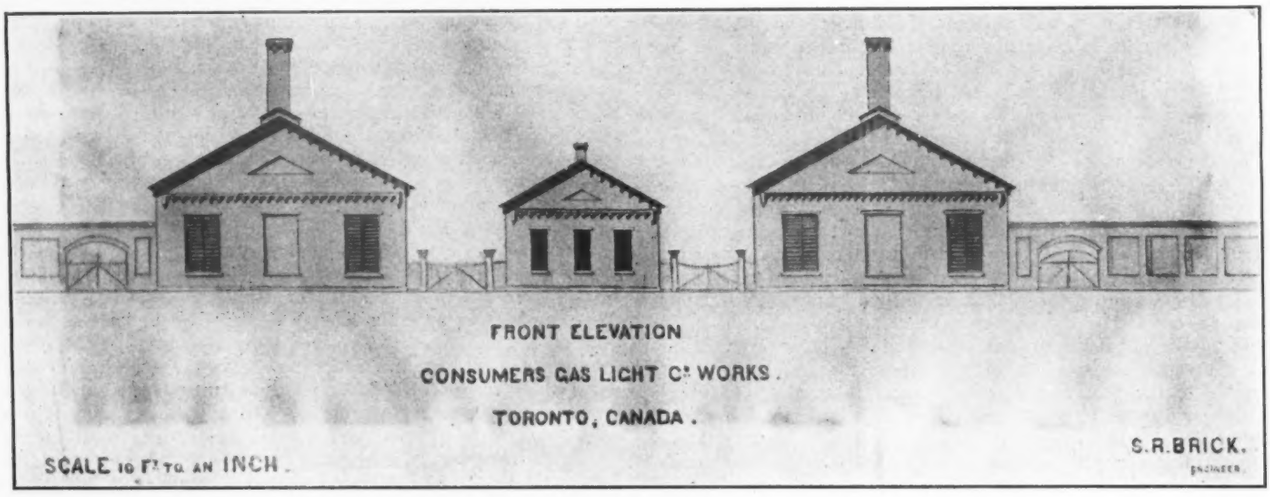


Fig. 1

was installed by which the coal is taken direct from the cars to the machines. The company has just completed new works of a daily capacity of five millions designed by their Engineer, Mr. W. H. Pearson, Junior, the principal new feature in these works being benches of 12's, the retorts being heated by producer gas. It would be out of place to occupy much space in giving a detailed account of these works, which may be furnished later on, but the accompanying photographs will give a good general idea of the works and some of the apparatus. These works, with the works already constructed, will have a total producing capacity of 12 millions cubic feet per diem, with a holder capacity of about the same amount.

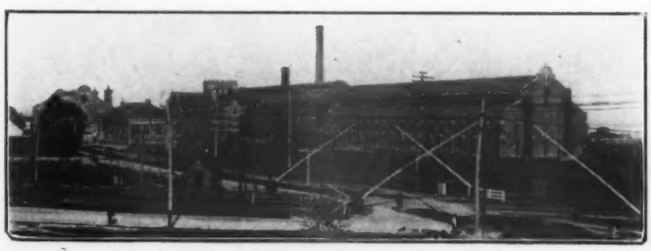


Fig. 2. New Plant nearing Completion.

The following is a list of the dates on which some of the earlier companies commenced operations:

Halifax	1843
Quebec	1849
Kingston	1850
Hamilton	1851
Brockville	1853
Belleville	1854
London	1854
Ottawa	1854
Charlottetown	1856
Brantford	1857

The prices charged by the older companies for the first year were from $3.50 net to $4. and one company (the Ottawa Company) charged $5.40. The first price charged by the companies formed between 1880 and 1900 was from $2 to $3 per 1000.

Some information furnished by an old timer may be interesting: "Oil in Canada was first discovered by the Indians floating on the water on Bear Creek in the neighborhood of Petrolia and the River Thames in the neighborhood of Bothwell. Indians gathered the oil by spreading blankets on the surface, and then squeezing the oil from blankets. It was sold and used as a cure for rheumatism and several other complaints. Oil in merchantable quantities was first discovered in Bothwell about 1859 or 1860, at Oil Springs a little later, and at Petrolia shortly after. At this time the price varied from 10 cents to 25 cents per gallon at the wells, and refined oil was selling at from 80 cents to $1 per gallon. The price of crude oil between 1859 and 1882 varied from $20 per barrel to 10 cents per barrel."

Canadian gas companies made fairly reasonable progress until the long period of depression after the boom of 1857. Owing to this, and to the general use of coal oil, about the year 1862, the business of gas companies was seriously affected until 1866. As an illustration, the output of the Consumers' Gas Company was reduced from 65,000,000, in 1857, to 27,000,000 in 1866.

Water gas was introduced in Canada, a short time prior to 1878, by the gas companies of the Town of Brockville and the City of Kingston. It was supplied in Toronto by the Consumers' Gas Company, in February, 1879, and was furnished exclusively to the citizens for a considerable portion of 1880 and 1881. Since then a mixture of coal and water gas has been supplied. The Toronto Company was probably the first company in America to supply this mixed gas.

It was not long before the company was attacked by the opponents of water gas, and, as in other places, attempts were made to prohibit its manufacture because of its containing so large a proportion of carbon monoxide. For a considerable time a strenuous fight was carried on, but eventually the company came off victorious.

Owing to the comparatively high price of gas, little was done in Canada in the way of introducing gas for heating, cooking, power or mechanical purposes until about 1879, when efforts were made by the Consumers' Gas Company, who commenced the manufacture of stoves which were rented, the rental to apply upon the purchase money. They also purchased and disposed of a number of gas engines, and reduced the price of gas for these purposes. In order to familiarize the public with the use of gas, it had an exhibit for several years of gas engines, gas cooking and heating stoves, and other gas appliances, with demonstrations of cookery, at the Toronto Industrial Exhibition, the result being a very large increase in that branch of the business. The writer believes that this exhibit was the first of the kind held in America. As is well known the business has expanded enormously—with most companies fully half of the consumption being for other purposes than lighting.

Considerable fear having been entertained that electric lighting would seriously interfere with the sale of gas, in 1879 the Consumers' Gas Company applied to the Legislature for power to produce and sell electric light. This application resulted in the passing of a general act, granting the power to all Ontario gas companies. The Consumers' Gas Company was prevented from going into this business by the refusal of the city council to allow it to use the streets for the purpose, as they feared it would destroy competition.

Prior to 1864 there had been no legislative or municipal inspection of gas. In that year the Legislature of Nova Scotia passed an Act entitled "An Act Relating to the Inspection of Gas in the

City of Halifax." The writer has not been able to ascertain the provisions of this Act, except that it enacted that the quality of the gas should be equal to 14 candles.

In 1873 an Act, which was almost a copy of the English Act, was passed by the Dominion Government, providing for the standards and apparatus for verifying and testing meters, which were to be retested every seven years. The gas was to be of a standard illuminating value of 14 candles and should have no trace of sulphuretted hydrogen.

An amendment to this Act was passed in 1875, in which, among other things, it was provided that, on account of the expense and difficulty in procuring coal of the proper quality in the Province of Ontario, the standard of illuminating power was reduced from 14 to 12 candles, and that of the Province of Nova Scotia increased from 14 to 16 candles. Provision was also made that gas should be tested for the presence of sulphur and ammonia, the percentage not being defined. Another amendment to the act limited the quantity of sulphur, in any other form than sulphuretted hydrogen, to 20 grains, and ammonia to 4 grains in 100 cubic feet of gas. Other amendments to the act were passed in 1890, 1900, 1901, and 1906, providing the place for testing, posting of notices as to the quality of the gas, penalties for tampering with meters by the public, installing meters before being verified or stamped by the inspector, what allowance shall be made to either the contractor or purchasers, in the event of a meter being found on reinspection to vary from the standard. It is creditable to the Canadian Gas Companies that in almost every case the conditions imposed upon them in these acts have been complied with.

From time-to-time a number of amendments have been made to the Consumers' Gas Company's Act of Incorporation. It may be of interest to state some of the provisions of an act passed in 1887, by which the company obtained the right to increase its capital stock to $2,000,000, the stock to be offered for sale by public auction in such amounts as the directors might decide upon in lots of 10 shares each, all surplus realized over the par value of the shares to be added to the reserve fund of the company, until the same is equal to one-half of the paid-up capital stock of the company:

"There shall be created and maintained by the company, out of the earnings of the company, another fund to be called the plant and buildings renewal fund, to which fund shall be placed each year the sum of five per cent. on the value at which the plant and buildings in use by the company stand in the books of the company, at the end of the then fiscal year of the company, and all usual and ordinary renewals and repairs shall be charged against this fund.

Any surplus of net profit, from any source whatever, including premiums on sales of stock, after the rest or reserve fund shall have been established and maintained as aforesaid, remaining at the close of any fiscal year of the company, after payment of fees to the President, Vice-President and Directors of the Company, (not exceeding in all the sum of $9,000 per annum), after payment of dividend at the rate of ten per cent. per annum on the paid-up capital stock of the company, and the establishment and maintenance of the said rest or reserve fund, and providing for said plant and buildings renewal fund, shall be carried to a special account, to be known as the special surplus account, and whenever the amount of such surplus is equal to five cents per thousand cubic feet on the quantity of gas sold during the preceding year, the price of gas shall be reduced for the then current year, at least five cents per thousand cubic feet to all consumers."

By the above it will be seen that the price of gas is to be automatically reduced, and that the consumer as well as the stockholder has an interest in the prosperity of the company.

The output of the Canadian Gas Companies as per Brown's Directory was as follows:

Year.	Output.
1893	1,609,745,500
1899	1,988,999,200
1903	2,391,734,400
1908	4,612,661,000

From the 33 reports received, the price of gas last year ranged from 75 cents to $2.40 per 1,000, the latter being charged by only one company, the average price being $1.41 for light and $1.21 for fuel.

Ten of the companies have sold out to municipalities. Of the non-municipal companies, six are paying no dividends; 1 pays 2½ per cent.; 3 pay 5 per cent.; 2 pay 6 per cent.; 2 pay 8 per cent.; 3 pay 10 per cent.; 1 reported, "Profits to extension," 5 not reported.

A number of gas companies in the southwestern portion of Ontario have suffered from the introduction of natural gas. A few companies (five in number) have been farseeing enough to obtain the control of it in their districts, while others have sold out to natural gas companies. Two are supplying both artificial and natural gas.

Only three companies out of the 33 from whom reports have been obtained, show a decrease in the consumption as compared with the preceding year. One company tells the sad tale that its business is almost entirely wiped out by the competition of electric lighting. According to "Brown's Directory," 16 companies are supplying both gas and electricity. The ability of a number of the gas companies to successfully compete with electric light is largely due to the reduction in the price of gas, the improved Welsbach mantles, improved burners, and securing a large consumption for other purposes than lighting. The Welsbach burners have undoubtedly proved to be the salvation of gas companies, as far as the lighting business is concerned.

Owing to the competition from electric lighting, and its comparative cheapness, partly from the use of water power, of which this country has such an abundant supply, the day has passed for gas companies to wait for business. In order to hold their own, they must, in common with other industries, send out active and intelligent solicitors, and adopt not only the most improved apparatus for the production of gas, but introduce the best appliances for its use and endeavor to convince the consumer, as is the case, that gas is cheapest, safest, and most healthful illuminant. By the circulation of literature, by courteous, prompt and intelligent attention to the consumers' requirements, the introduction of labor-saving machines, and the adoption of the most modern systems of account keeping in the official department, to all of which some of the gas companies in Canada are fully awake, they are enabled not only to retain, but to largely increase their business.

The gas companies of Canada have been somewhat tardy in forming an association. It is, however, pleasing to refer to the fact that a Canadian Gas Association was formed, November, 1907, with the respectable membership of 76, sixty-nine of whom were present at the first meeting held in Toronto on the 26th of June, 1908, the first President of the association being Mr. H. W. Powell, of Brantford, and the Secretary was Mr. A. W. Moore, of Woodstock.

Progress of the Gas Industry of Great Britain During the Last Fifty Years.

[Prepared by Mr. Norton H. Humphrys, Salisbury, England.]

The extent and amount of detail covered by this title is such, that a bulky volume could be occupied in doing adequate justice to it, and the ordinary limits of a magazine article admit of little more than a crude and bare outline sketch. Avoiding detail, attention will be directed to the more prominent features, and it must be remembered that progress of the gas industry is partly based on the general progress in education, science, art, and research, which largely increased the materials at command, and the methods of dealing with them. One need only instance the introduction of steel and ferro-concrete, the advance of photography, both in a general way and as a means of duplicating drawings, the improvements in laboratory apparatus and methods for the examination of solids, liquids, and gases, the introduction of machinery for the handling of solid materials, the greatly increased facilities for traveling and for acquiring information of all kinds, as illustrative of this fact. The upshot of it all is that the vigorous but untrained young sapling of 1859 has become a sturdy giant of the industrial forest. The latest official government return at hand (that for the year 1906) deals with the affairs of 783 statutory gas undertakings. These have afforded opportunity for the investment of 126½ millions sterling as capital outlay. The annual income is 28, the expenditure 21, and the profits 7, all in millions sterling. Nearly 15 million tons of coal have been consumed in generating 182,000 million cubic feet of gas, of which 168,000 millions have been sold to 5½ million customers, and distributed through 32,690 miles of main pipe. These returns do not date back further than 25 years, but within that period the increase in every department is surprising. It has more than doubled, not by leaps, but by a steady, sustained advance over the whole period. Looking at the fact that many of the large undertakings of to-day were not known in 1859, we may

draw the conclusion that the consumption of gas, and quantity of coal carbonized, have increased fourfold, and that the number of consumers and mileage of mains (for reasons to be noticed later) has grown to an extent of not less than six or sevenfold. These figures are large, and they represent a corresponding growth in the opening for honest employment, both directly in the manufacture and distribution of gas, and indirectly in the supply of materials and apparatus. More than one-third of the total expenditure may be set down as wages, and we can, therefore, claim that gas occupies a very important industrial position in the affairs of the nation.

The selling price of gas has been reduced quite one-half, notwithstanding altered industrial conditions, especially increased cost of labor, that have tended to a substantial rise in the general cost of commodities. The gas bill of to-day is less than in 1859, but the total cost of living is much greater. The reduction is really larger than the actual difference in cost, and has been brought about by the lessons of experiences, economies incidental to a larger scale of operations, and by improvements applicable to large and small alike. In a similar way it may be said that the increased consumption of gas is larger than the figures actually shown, because one cubic foot of gas will now give 10 to 15 times as much value in the form of light, and burn three times as much in the form of available heat, than could be obtained from it in 1859.

Gas now retains, and always has retained, a prominent position as a lighting agent notwithstanding several disadvantages. The numerous applications coming under the head of fuel, either for domestic or technical operations, have taken such a prominent position that they have tended to eclipse or conceal the progress of gas as a lighting agent. At times they have taken the lead, and attracted the greater amount of attention, to the disparagement of the lighting department. Whilst they were fostered and encouraged in every way, as a source of day and of summer consumption, it was tacitly assumed that the lighting could take care of itself. It strikes one as an anomaly, to find concerns claiming the title of Gas Light Companies, doing all they can, and offering liberal inducements for encouraging the use of gas for cooking, heating, motive power, and technical purposes, but leaving the lighting department unaided, and thus incidentally assisting the endeavors of those who are interested in circulating fairy tales to the effect that the days, or rather the nights of gaslighting are ended. Notwithstanding this and some other circumstances to be mentioned, the use of gas for lighting has shared in the general advance, and probably twice as much is used in that department to-day, as in 1859.

The progress of the gas industry has been greatly facilitated by wise Parliamentary regulations, under which the undertaking is secured from competition within an agreed district, subject to regulations as to selling price and maximum rate of dividend. And later, by the sliding scale which offered the inducement of an additional ¼ per cent. to the rate of dividend, for every reduction in price of a penny per 1,000 cubic feet below a figure called the initial price. The only defect in them is the regulations as to illuminating power and purity, which are carried to such a degree of refinement as to involve much unnecessary expense. It is a heavy item for a small company to be compelled to spend £100 or so in fitting up a photometer room which may be rarely or never used. We have remarked on the gas industry as an outlet for labor. Under security afforded by a special Act of Parliament, it becomes a good home investment that capitalists are not slow to appreciate. The average gas company can raise as much capital as will meet its reasonable requirements at 5 per cent. interest or less, and cheap capital means cheap gas, because it reduces the difference between income and expenditure.

Let us glance at the gas works, as it existed in 1859, and compare it with the works of to-day. In a small works reaching 10 millions or so per annum, the clay retort was a novelty at the earlier period. A good carbonizing heat and a make of 10,000 cubic feet per ton was regarded as a doubtful innovation, perhaps indicative of push and enterprise, but not without counterbalancing disadvantages. There was considerable discussion on the subject of high *versus* moderate heats. The foul main, and exhauster, were, for the most part, absent, the condensing, washing and purifying apparatus was of a very primitive indifferent type and probably much too small, as we now understand it, for the winter make of gas. The same applied to the holders, which were of such limited capacity that, unless quite full in the afternoon, they would be empty by midnight. Stoppages at any point between the retorts and purifiers were of periodic occurrence, and regarded as unavoidable, while the purifiers were emptied and recharged several times in a week. The manager did not expect to get through the winter without a few all-night jobs, and was accustomed to being called upon at all sorts of hours, day and night, and if successful in maintaining a full supply of pure gas throughout the heavy season, was credited with more than ordinary skill. The outdoor department was let out to a firm of plumbers or ironmongers, or represented by one jack-of-all-trades, who laid sewers, proved meters, and did the blacksmithing and odd repairs at the works.

To-day, in a works of similar size, we should expect to find the bulk of the carbonizing done in simple but effective settings of the generator type, and one or two small, old-pattern grate settings retained for intermittent use, on account of the facility with which they can be brought into operation. There will be a foul main, condenser, washer, and purifiers of ample capacity, the connections all cleaned out in a methodical manner once every year, without waiting for stoppages to occur, and any cessation in the regular make of supply of gas is quite the exception. There will be an exhauster, probably drawn by a gas engine. The holders are larger, owing to the introduction of day consumption, and the incandescent burner, the fluctuations in stock over different periods of the 24 hours, that were formerly so trying, no longer exist. The outdoor department requires two or three artisans, who carry on gas-piping work of all descriptions, fix installations on the slot meter system, and perhaps also keep incandescent burners in good order. The set of two or three memorandum books, the pages of which show unmistakable evidence of the fact that the manager also undertook manual labor on the works, and which constituted the records of the affairs, by a simple but effective system of specially ruled books, both for financial and for working records, that enables all the principal items of income and expenditure to be under continual control, and gives all the details required for the preparation of an annual statement of accounts. Bookkeeping and drawing up balance sheets are now matters of common knowledge, whereas in 1859 the art of double-entry was unknown to those who could not get a special training, and the methods taught were both complicated and cumbersome, requiring much unnecessary labor. Even large concerns kept little more than a ledger and cash account showing the receipts and expenditures, and as instancing the looseness that prevailed in these matters, the methods of a small country gas works may be stated. There was a kind of deed of partnership setting out the amount invested by each partner, and the secretary was also the banker. Every year he called the partners together, presented a cash account, and produced the balance of profit in cash, which was pooled out to each partner in proportion to his investment. As a general rule, the only form of annual account issued to the shareholders prior to 1859 was a simple "Cash Account," affording no details as to coal used, gas sold, etc. Sometimes no bills were rendered, the manager or his assistant simply calling at the consumer's house, reading the meter, and demanding the amount due, which was considered payable forthwith.

The large gas works of 1859 presented little, if any, advance in the matter of general engineering features, over the small one. When we say that the buildings and plant is no larger, and that there were more retorts, the ground is fairly covered. In a few instances some curious attempts were made in the way of infusing such an ornamental character into the design, as to render the works an embellishment to the landscape rather than a disfigurement. Owners of large houses objected to the sight of a retort house or gasholder from their principal windows. But the day of retort houses modelled on the lines of a feudal castle, or gasholders with Grecian columns and polished horizontal girders, soon came to an end. The idea of ornamental design on a more limited scale died hard, and for years questions of general appearance took the precedence over the plain utilitarian that is now the general rule. One extravagant notion was the single or central chimney, and that usually carried much higher than was absolutely necessary, either for insuring a proper draught, or diffusing the smoke. Even in country towns chimney stacks 100 feet or more high were to be seen, and including foundations they represented a great expense. The designer of a works of any pretensions as to size was expected to provide an harmonious whole, from an architectural point of view, with the aid of moldings, panelings, string courses of various colors, pediment courses and cornices, etc., while the gasholder framing was adorned with spear or lance head pivots, rosettes or shields covering the crossing of bars in the lattice girders, etc., and the columns were unnecesarily large and heavy. All this has given way to avoidance of superfluous ornament. Buildings are plain, but not necesarily ugly, and no attempt is made to embellish the gasholder. Considerations of an æsthetic kind have been swallowed up by the sordid consideration of first cost, and whereas the engineer formerly pointed with pride to the symmetry

of the design as a whole, he now produces a sheet of figures proving a gain in the matter of cost per ton of coal carbonized or per 1,000 cubic feet of gas made per annum. Apart from the engine, exhauster and pumps, there was no machinery worth the name, but all the operations were conducted by means of hand labor.

The great improvements in adaptation of machinery to the retort house work, and to the conveyance, stowing, or loading of coal and other solid materials, are chiefly responsible for changing the appearance of the large works of to-day to such an extent that it is barely recognizable on the lines of 1859. If there is a water connection, which is preferred on account of the cheapness of water as compared with rail traffic, the coal comes up to the quay in large steam lighters, and is rapidly unloaded and dropped where required by the aid of grabs, skips and chain or band conveyors. It may go to the store heap, or direct to the breaking machine, which is an indispensable adjunct to mechanical drawing or charging. From this it passes on to chain bucket elevators, and to overhead hoppers, whence it can be delivered as required, direct by gravity into vertical or inclined retorts, or to the charging machine, if horizontals are still retained in use. If there is rail, but no water connection, the trucks are brought on to a system of overhead sidings by means of the works locomotives and tipped on end by hydraulic power. When worked off the spent charge is allowed to fall out by gravity from inclined or vertical retorts, as one of the advantages peculiar to these arrangements, is the utilization of the force of gravity in connection with the work of charging and discharging. With the horizontal retort the gentle persuasion of a hydraulic pusher or ram expels the coke, and in one arrangement that is extensively used, the ram that expels the coke carries in behind it the next charge of coal, so that both operations are effected at one stroke. A shoot or scoop is used to direct a sufficient quantity of the spent charge directly into the furnace, and the excess remaining for sale is received on a traveling conveyor extending the whole length of the bench, at or about floor level, as here the coke is cooled by numerous jets of water. It is received by conveyors or strong steel tipping buckets and carried to the breaking and sorting machinery, or to the store heap, as required. From the breakers and screens it goes to overhead store hoppers from which it can be delivered into sacks, carts, rail trucks, or lighters. Conveying machinery is also used in the purifier houses, and the use of so much machinery necessitates quite an imposing set of workshops, with all necessary equipments for forging, drilling, turning, planing, cutting screw threads, etc., and to any engineer of a constructive turn of mind, this set of shops becomes an interesting and engrossing feature. Many are pleased to take a friend through and point out the details of the various machines, and this department occupies the same position to the gas engineer as the orchid house or stables take in the estimation of country gentlemen. In place of the exclusive use of steam we now find rope traction, compressed air, hydraulic power, electricity, etc., all claiming their respective values, and producer-gas is frequently used either directly or as a means of generating steam. There are yet a few works where, on account of local consideration, water-gas is not used, but in the average modern works a carburetted water-gas plant, equal to 40 or 50 per cent. of the whole make, is a distinguishing feature. It is useful not only for meeting the sudden increase in demand at holiday times, or in severe weather, but also as enabling the coal gas plant to be kept in continuous operation. With grate furnaces, that must of necessity be let down after nine months or so, for the purpose of re-lining, it was easy to arrange that each setting had its full maximum run. But the modern regenerator setting will run on for two years on end, and also is more costly and troublesome in the first taking up. So there are many who, with plenty of holder room to take care of sudden fluctuations in demand, nevertheless find the water-gas plant a useful auxiliary in connection with large modern furnaces, or for lifting surplus coke off the market.

When water-gas came into use there was a small "carbonic-oxide" scare; but it was confined to one or two towns, and never assumed any important proportions. There was some talk about a limit in respect to percentage of carbonic-oxide and something of the sort has been agreed to in a few instances. But experience has shown that there is no special danger, and now the scare is quite a thing of the past. Some large companies unblushingly own to the soft impeachment of distributing over 50 per cent. of carburetted water-gas ("death dealing compound"—*vide* the armchair scientific howler), but no one troubles or is "a penny the wiser."

Amongst the principal structural alterations may be instanced the substitution of wrought-iron or steel framing, or the use of ferro-concrete in the place of bricks or masonry, by which not only the cost of material, but also the weight of the structure is reduced, thus greatly decreasing the cost of foundations on a bad soil. Light steel girders have displaced heavy iron castings to a large extent. For subsidiary buildings, such as coal or general stores, workshops, etc., corrugated iron, either black or galvanized, is largely used. Seeing that in either case the work must be periodically painted, many prefer black iron as being stronger. The waterseal and heavy loose cover of the purifier has been replaced by the dry joint and light flat lid, thus largely reducing the cost, especially in regard to connecting pipes. The overhead arrangement, which involves a costly system of thick walls and supporting girders, at one time very popular, has given way to boxes buried nearly to ground level. In place of the center valve, always a source of trouble, and the elaborate network of pipes under the purifiers, much simpler arrangements are used. With the dry cover there need be no limit to the size of the vessel, because the cover need no longer be in one piece. Even in the largest works the heavy Goliath, with frame straddling the whole breadth of the vessel, is no longer necessary, light chain-blocks being now sufficient for raising or lowering the covers. As a result, the tendency is in the direction of larger, and fewer, boxes. The value of broken firebrick from burnt-out furnaces, and of hard clinkers, is now fully appreciated, as a material for mortar and concrete, thus many gas works, all retaining walls, gasholder tanks, etc., are constructed with the aid of these refuse materials. Steam is raised for works purposes by the means of valueless residual material such as pan breeze or coke screenings, with the aid of forced draught furnaces. Where iron gasholder tanks are a necessity, steel or wrought-iron has entirely displaced cast, and as much may be said for the standards or framework. Gasholders now run into as many as six lifts, and partial or entire displacement of outside guide framing is adopted to a large extent, though it cannot be said to have come into general use. There are many who contend that the saving in cost of standards and framing is more than covered by the cost of the self-contained guides, which must of necessity increase the working costs of supervision and maintenance. Steam is now generally used as a means of preventing the formation of ice in holder tanks during frosty weather. Every works, over 20 millions per annum in capacity, now makes up the ammoniacal liquor into sulphate of ammonia on the premises.

The changes above indicated, in connection with the manufacture and purification of gas, are very extensive; but they are surpassed by those in the outside department, to which attention will now be directed. Its principal features, as now understood, have developed, if not actually come into existence, within the later part of the period under review. There has been a remarkable change in the habits of urban population, rendered possible by improved means of transit. The well-to-do storekeeper no longer resides over his business premises, but at the close of the day goes off by rail, trolley car, or motor car to his "little place" out in the country. His assistants and laborers no longer occupy crowded tenements in the immediate vicinity of the warehouse, but take the train, or ride a bicycle, to a suburb four miles out or so. This has tended to a large expansion, and to the grouping together of several townships in one gas supply district. Large cities, at one time 10 miles apart, are now practically joined, each having thrown out suburbs four or five miles from its center. And this development of outer suburbs is peculiar to all kinds of towns, manufacturing or otherwise. The general result is that the area of the district to be supplied has increased perhaps 12, perhaps as much as 20-fold, necessitating an entirely new organization of the outdoor department. Formerly the bulk of the consumption was confined to a comparatively small area at the center of the district, but now it is more evenly spread, and important suburbs at the outskirts call for as much attention as the principal streets of the town.

In respect to the gas industry one can recognize a similar kind of expansion. While retaining the original center as represented by the works and mains, a large number of appendages have been added, especially as regards the commercial end of the business. In 1859 the other side of the consumer's meter was an unknown and an unexplored territory, and there was nothing in the way of stoves on hire, slot installations, or maintenance of burners. A few energetic and far-seeing gas managers were in various ways seeking to assist the consumer by the issue of instructive pamphlets or by letting gas-cookers on hire, but the majority looked upon these proceedings with a certain amount of amused contempt, as partaking of quixotic zeal, and lowering the dignity of the profession. Now we are able to congratulate these gentlemen as being wiser than their *confrères,* for it is evident that during the period previous to about 1890 a great deal of valuable ground was irrecoverably lost for want of that energetic action which to-day is the usual thing, but was then the exception. When one sees the re-

sults secured in other directions, on a much smaller basis, by sheer cock-a-hoop assurance and bounce, aided by the negligence already referred to, he cannot but admit that in the matter of developing sales, advertising, etc., the gas companies have had a period of Rip-Van-Winkle-like repose, from which they have only lately aroused. They have been lulled by a steady 3 or 4 per cent. increase in output each year, but have failed to see that this is not an absolute limit. Many concerns that are selling 100 millions a year to-day, should and might and ought to be selling 150 to 200 millions. We can scarcely enter upon comparisons as regards the consumer, because, in 1859, and for years after, he was only known at the gas office as a party who paid a bill. The duty of the gas supplier was considered to end at the consumer's meter, and the inside work was undertaken by builders, plumbers, or ironmongers. Anyone who could screw a pipe or blow a joint could call himself a gasfitter. Nor were the gas companies entirely to blame for such a state of affairs, as there was a general disposition to resent any interference of the gas company in this domain. It was thought they could only have one object in view, and that was to increase the quantity of gas used. The natural results of using gas pipes and fitments selected and put together by persons ignorant of the properties of gas, led to some few attempts to form associations or adopt other means for the education of gasfitters. In many country districts there are still many undesirable relics in the way of badly fitted houses, that have been and still are a prejudice and serious hindrance to the progress of gas, and the problem of to-day is how to get them replaced by modern and efficient systems. An inefficient and extravagant fit up makes the best of all hunting ground for a competitor in trade.

The distribution department, using the word in a narrow sense as referring to the arangement and control of main pipes, has expanded so much that it tends to become a separate profession. Every large town has its distributing engineer, who is responsible for the whole of the mains in the district. The aid of high pressure or mechanical distribution, as distinct from natural or holder pressure, is becoming a necessity, if only for the purpose of conveying gas to distant distribution stations. The existence of convenient water or rail connection may render it advisable to make the gas at some outside locality at a distance from the main center of supply quite apart from other obvious advantages gained by concentrating the manufacturing plant, such as the greater facility for the application of machinery. In our larger towns, where formerly there were half a dozen or even a dozen gas works dotted over the district, the tendency is towards concentrating the manufacture at one or two favorable sites, disposing of the others or utilizing them for gasholders only, as the larger works only may be run continuously throughout the year, and the others brought in to help tide over the heavy season. The displacement of cast-iron in favor of wrought-iron or steel is also much in evidence in connection with distribution. Lighter, more elastic and stronger metal is gradually replacing the cumbersome and brittle cast socket and spigot pipe. Although viewed with some suspicion, as not likely to prove durable, particularly in damp soil, its many advantages are making way, and it is gaining in favor. It is curious that engineers who raise no scruple about laying long lengths of service pipe, up to 2 inches diameter, should so obstinately kick at a 3-inch or 4-inch main of that material. If properly laid and coated with tarred jute, care being taken to render the coating intact at joints or branches, and to repair any accidental scratches received in transit or handling, there need be no hesitation on the score of durability. Pipes that have lain in the ground for 10 years are known to be quite sound, the covering being as fresh as when first laid. They can be had in lengths up to 40 feet, thus saving two out of every three joints and they admit of a considerable amount of springing in order to avoid obstacles or follow a crooked road, which means a saving of special castings. The delivering capacity, size-for-size, is appreciably greater, as might be expected considering the smoother character of the interior surface, and the less frequent breakage of its continuity by joints. Another objection that does not come to much in actual practice, is the thinness of the pipe as regards the necessity for a sound branch or service junction. A saddle and thimble can be used if preferred, but it is found that two or three threads in the more elastic or tough material are as strong and as gas-tight as the average connection to a cast iron main, of the usual thickness. With the cast socket pipe the only way of enlargement, when more gas is wanted, is to take it up and relay with larger, but with the steel pipe there is also the choice of augmenting the supply by increasing the pressure. Outlying townships and villages, formerly considered outside the bounds of economical gas supply, are now being connected up with the aid of steel pipe and high pressure. And the district gas company, which takes up an area of say 20 miles square, in place of one town only, is becoming an accomplished fact. The manufacturing stations are located in the most favorable locality and not of necessity in the center of the district, and lines of steel pipe are carried to the places to be supplied.

The development of a proper understanding between the gas company and the consumer, was not accomplished at one stroke, and the first important step in this direction was due to a third party, the man who made gas cooking stoves and wanted to increase his sales. He perceived that not one consumer in 100 would go to the expense of buying a stove right away, and that there was room for a large development on the lines of letting or hire. He began to cooperate with gas companies by arranging facilities for holding exhibitions and practical demonstrations of gas apparatus, bearing the bulk of the expense, if the gas company, on their part, would inaugurate a scheme for supplying apparatus on hire. Some fought shy of the initial outlay, and endeavored to reduce it by a charge for fixing, or hire-purchase terms on the three yearly instalment plan. But the results were such as to encourage the most timorous, and the thing soon settled down into the supply on simple hire, with no charge for fixing under ordinary circumstances, at a rent which was practically as much as consumers were inclined to pay without kicking. The rent is payable quarterly, and each instalment is about 1/30 part of the retail cost of the appliance, when fixed complete, anything over 30 feet run of supply pipe being considered and charged as an extra. For example, a stove retailed at £5 would be charged at 3/- to 3/6 per quarter. The movement was successful in respect to its primary object, and many undertakings to-day have 70 to 80 per cent. of their consumers also hiring gas appliances. The gas exhibition became a general thing, some companies holding one annually, and the leading firms of stove makers retained the services of perhaps half-a-dozen skilled lady demonstrators, thus anticipating, by some quarter of a century, any similar action on the part of gas companies. They also followed up the thing energetically with improvements in the efficiency and reductions in the cost of their apparatus. Perhaps the mistake at first, as with so many other novelties, was loading the apparatus with too large a proportion of profit, but this has been remedied for many years, and the cost of the cooking stove is such that the hire will give a fair return on the outlay, without considering the additional sale of gas. A rent of 1/6 to 2/. per quarter will cover interest and depreciation.

But the movement was destined to have results very much wider and far-reaching than at first expected. The exhibition and cookery demonstration brought the gas manager and the gas consumer into personal contact, thus driving the last nail into the coffin of many old prejudices and errors. The consumer was accustomed to regard the people at the gas works as devoting their sole energies to the piling up of the gas bill by fair means or foul, and, of course, the latter by preference. We heard sinister rumors as to the quantity of gas made per ton, and about the big rotary pump at the gas works, supposed to be used for pumping in air, for admixture with the gas, all air so gained being charged to the consumer at the current rate per 1,000 cubic feet. All the evils due to the ignorance of the gasfitter were piled up at the door of the gas works. The manager knew nothing of the consumer apart from an occasional dispute about the bill. The consumer, witnessing the operation of appliances properly fitted, was amazed at the efficiency and also the economy of gas, and the manager soon perceived that the sound and proper policy was to offer every assistance in enabling similar results to be realized by any and every customer, in his own house. The complaint, inquiry, and order department became a feature in every gas office, and to-day no one would think of a large alteration to his appliances without consulting the manager, if the concern is small, or the attendant at the nearest show room in a large town. The hire department acquired such proportions as to call for a special staff of skilled workmen, and for workshops and stores, and soon extended to other appliances, as well as to the supply and fixing of apparatus of all kinds on sale. Matters were greatly assisted by the Crystal Palace Gas and Electric Exhibition, of 1881-2, which attracted visitors from all parts of the country. A series of practical tests and experiments were conducted with the apparatus on view, that were of immense service to all concerned, in settling up several debated points and in crystallizing out the leading features of the efficient and economical gas heater and cooker. The exhibition had a useful educational effect as regards directors and shareholders and tended to reduce the opposition that every pushing and go-ahead gas manager received at that time, from the more old-fashioned or cautious section of his stockholders, many of whom were not inclined to risk any important amount of capital in the hire department.

Following close on the Crystal Palace Exhibition came the high-power lamp, comprising either clusters of flat flames, or inverted argand burners on the regenerator principle. Hitherto the public, and even some gas people, considered that the flat-flame burner, giving 10 to 15 candle-power, represented the full capability of gas for lighting, and that if a center of say 500 candle-power was required, there was nothing but the ghastly jumpy electric arc. The lantern combinations exhibited by Messrs. W. Sugg & Co., by Messrs. George Bray & Co., and others, effectually disposed of this idea by affording practical proof that light centers, up to 700 candle-power, equal in practice to the so-called 2,000 candle-power electric arc could be furnished by means of gas, and that the flame could be rendered absolutely steady. These high power arrangements became very popular and in general demand, for important thoroughfares, bridges, crossings, and refuges, entrances to public buildings, etc., as well as for inside light, and secured for gas a position that it has retained to the present day, a position that increases in extent and importance notwithstanding the advances made in connection with other agents.

Meanwhile the incandescent principle—a marvelous invention that practically reduced the cost of gas quite fourfold— was gradually taking practicable form, and has now entirely replaced the combinations above instanced, which in their time did the useful work of retaining the high power center position. The best duty hitherto obtained from the ordinary size flat flame did not come up to 4 candle-power per cubic feet of gas used per hour and the best of the high power combinations gave perhaps 10 candle-power. When the Welsbach Company claimed a duty of 20 candle-power for their new burner, they were received with incredulity. But subsequently this high result has been more than doubled. They brought the important advantages of a high duty, an absolutely steady light, a color or absence of color that represented the best obtainable substitute for daylight, the reduction of any nuisance from products of combustion to an absolutely negligible quantity, and complete combustion with no smoke and no soot, within the reach of every consumer. There were those who ridiculed the possibility of the fragile mantle ever taking on an important place in the public esteem. Yet in 20 years we find that the incandescent light has almost entirely displaced all other forms, such as the flat flame, large or small, single or in combination, the argand, and the regenerator. Like the cookery demonstration the incandescent burner also brought in many incidental advantages. The fragile nature of the mantle, considered to be an insuperable drawback, proved in some respects a blessing in disguise, by calling for care in heating and regulating the supply of gas, and in driving the self-educated gasfitter, or the gasfitter with no education at all, off the scene. The great drawback up to this time had been the practice of sticking up gasburners anywhere or anyhow, with no adequate protection from cold draughts, and the obvious result was a more or less flickering light that tried the eyes, and the production of soot and products of incomplete combustion. This was especially evident where the local authorities had made the mistake of standing out, on behalf of what was presumed to be the interests of the public, for a high quality gas. Isolated and spasmodic endeavors were made to educate the public on these matters, by parties who were interested in hygiene and economics, but to this day the disadvantages first noticed are popularly supposed to be inseparably associated with the use of gas, and gas companies have reason to regret that they have not in the past taken more active steps towards the vindication of gas from the penalties of careless and ignorant usage. By mostly refusing such barbarous treatment, the incandescent burner benefited the cause of gas. Gas companies found that, to do the system justice, they must undertake the maintenance of the burners, at a fixed charge per year, and this important department was an additional aid to the good work of establishing familiar contact between the consumer and the gas office. The experience gained by actual practical association with the users has led to continual improvements in all details. Perhaps the most important of these is the inverted, or the inclined burner, by means of which the mantle can be located at any angle from the vertical.

It is curious that although at first many kinds of anti-vibration arrangements were put forth, and also tinted or colored glass shades for subduing the light, and regarded as indispensable appendages, they are now entirely discarded, with the exception of factories, railway stations and other localities specially liable to vibrations. In general use we find a plain, white, opal shade, and no anti-vibration arrangement.

But there was a serious aspect from the supplier's point of view. It was very nice for the consumer to be able to reduce his consumption to about one-fourth, but there was the effect on the gas work-rental book to be considered. We may be reminded that increased cheapness leads to increased demand, but the reduction to the consumer is immediate, while anything like a proportionate increase must necessarily be a matter of time. Meanwhile a serious setback might be expected. But there is no instance on record of such an important increase in duty, with so little apparent effect as regards the quantity sold. The fact that steady unbroken increases in sales of gas have been the usual experience during the period covering the establishment of this new system, even in towns that are stationary as regards commerce or population, proves the existence of some compensating cause apart from the larger demand incidental to the cheaper light.

This was furnished by the slot or automatic meter, which was introduced at or about the same time as the incandescent burner, and the two taken together constitute by far the most important and far-reaching innovations to be recorded in connection with our industry. By far the greater proportion of gas used for lighting goes through incandescent burners, and the automatic meter has been so eagerly taken up that in many towns the number of slot consumers has overtaken and actually exceeded that of the ordinary consumers. We have observed that the use of gas cookers did not become extensive until they were supplied on hire-terms without initial outlay on the part of the customer, and the advent of the slot meter brought out the fact that the same thing applied to gas-fittings generally, and that a large number of people were willing to use gas, but deterred from doing so by the cost of the fittings. Weekly tenants are not inclined to spend much money on tenants' fixtures, even if they have it to spend, and owners of that class of property find that the smaller the proportion of removable accessories, the better the relations between landlord and tenant. It was evident that the slot meter would prove of very limited application without the help of a free-fitting arrangement, and the slot-fitting agreement came into use, under which the gas company supplied an installation worth perhaps £5, including meter, small cooker and one or two lights fixed complete. The landlord or owner was required to sign an agreement acknowledging that the fittings belonged to the gas company, and could not be seized in distraint for rent due. The meter is set at an advance rate on the ordinary price, perhaps 9 d. per 1,000 cubic feet, to provide interest and depreciation on the outlay. The system is open to criticism, apart from the opposition usually awarded to innovations of any kind, but if wrong in theory it has proved right in practice. The convenience of including all charges in the coins inserted in the slot, together with the absence of bills and applications for money, has secured it a favorable reception everywhere. A low loading or none at all, with gas at the usual price, and a rent for the fittings that does not vary with the quantity of gas used, may be more equitable and advantageous; but it is difficult to collect the rents, and attempts to do business on these lines are the exception, although one or two successful efforts are on record. The average consumer regards the coin insertion as full payment and resents any attempt in the direction of a second contribution as a dishonest imposition. But if he is willing, there is the revival of the objectionable feature of being pressed for payment, to say nothing of the expense of collection, and the large proportion of bad debts. Certainly the large customer has to help pay for the small, and in this respect there is a resemblance to the fixed rate per 1,000 cubic feet of gas, which has been proved over and over again to be unsound and inequitable in theory, but nevertheless retains a firm position in public favor as a most convenient basis of buying and selling.

But the great advantage of the free-fitting system is that it completes the work begun by the exhibition of cookery demonstration, by securing for the gas company the entire control up to the point of combustion. In practice they are held responsible up to that point, being usually blamed for all defects, but till the advent of the free-fitting system they never had it in fact. There is increased responsibility, but a large body of contented customers is the best possible advertisement, and many of the ordinary and older customers are beginning to see that the newly-fitted up slot customer enjoys a more efficient and a more economical service. The free-fitting system should be extended and fittings supplied on hire terms to all classes of consumers, especially in towns where the customers suffer annoyance and inconvenience, and the gas company lose much business by reason of the fact that the gas-fittings are wornout and leaky, pipes choked, etc. But the average customer, if he does anything at all, will not go beyond a little cheap patching which makes matters worse rather than better. He thus becomes an easy prey to those interested in other forms of lighting, who are shrewd enough to utilize his position to their own advantage, and

who do not hesitate to make comparisons between the former state of things and the new installation including every available improvement.

There has also been a great change in the general methods of conducting business. In 1859, systematic advertising, issue of pamphlets, and personal soliciting for sales were unheard of in substantial business circles. It was the pride of the old-fashioned tradesman that he had never solicited an order, the inference being of course that the quality of his goods and the fairness of his prices rendered these aids unnecessary. Gas companies held this idea very firmly, and so far from meeting the new customer half-way, made him sign all sorts of forms, and in some cases pay a fee for tapping the main, while the increase of consumption was quoted in the board room as evidence of an enterprising and liberal policy. Some would not lay a service pipe or go to any expense inside the premises of a consumer, considering their duty to end at the boundary of the public road. All this is entirely a thing of the past. In addition to instructive pamphlets, systematic endeavors are made to secure all available new business, some going so far as to canvass the district house-by-house. Advertising in all the usual forms is freely resorted to. Services up to 50 feet in length are laid, and the meter fixed, free of cost, and advice or information as to the various uses of gas is readily obtainable.

In a modern gas works there is absolutely no waste, and nothing is given away. For some time the residuals were regarded as waste products, and no attention was directed toward cultivating or developing a market for them. In a small works the tar and liquor would be thrown away, and almost anything except coke was to be had for the asking, while large works disposed of the products at a nominal price, thinking more about getting rid of them than of making money. But now the arrangements for disposing of the products are of a complete and elaborate character. Coke is broken and screened into various sizes to suit the local demand. Road tanks are provided for the delivery of tar and liquor. Any burnt brick clinker or screenings command a small but regular price. Refuse lime from the purifiers can readily be sold, and oxide of iron, when charged with sulphur to the extent of 50 or 60 per cent., will sell at a rate about equivalent to the cost of new material. The gas company either have their own carts, horses or motors for delivering material in parcels large or small, according to requirement, in all parts of the district. Quite a respectable portion of the coke is sold in single bags to the poorer classes. It was considered a wonderful thing when the residuals realized a sum sufficient to pay the shareholders' dividend, but that limit has been considerably improved upon, and the development of the residual department has largely assisted in the gas business by reducing the working costs per 1,000 cubic feet of gas made, and thus enabling gas to be sold at cheaper rates. It is no longer necessary to deplore the existence of by-products in the manufacture of gas, but they are welcomed as an important adjunct.

So much for the past; but what about the future? Men get old, and in course of nature pass away. The pioneers of our industry have long since gone to their well earned rest, and those who have borne the brunt of the battle during the period under review must soon follow. But the gas industry of to-day exhibits none of the decrepitude or weakness incidental to old age. On the contrary, it retains the full vitality and facility for growth that is peculiar to youth. There are those who say that the pages of history are dry and musty. They may appear so to one who merely wishes to find amusement for an idle hour; but to the earnest student the achievements of the past afford inspiration and guidance as regards the possibilities of the future. The successes indicate the lines to be followed; the failures, those that should not necessarily be avoided, but carefully examined. The fault may not be fundamental, but merely a matter of detail that can perhaps now be successfully dealt with. The failures of to-day may possibly lay the foundation for the successes of to-morrow. The steady advance, as regards available means for obtaining knowledge of all kinds, is continually providing improved weapons for the fight, and the young man who has finished his training and is entering on his profession, succeeds to a goodly heritage, and finds increased scope for energy, industry and skill. There is sometimes a disposition to regard modern refinements as an aid to shorter hours of labor, and generally to an easier life. But this is a mistake, so far as regards the responsible parties to whom is committed the control of operations. The regenerator furnace, the mechanical conveyor, etc., call for a higher degree of technical skill and organizing capability than was necessary to keep the older and simpler forms of apparatus in going order. We must avoid the mistake of supposing that improvements of an up-to-date character will take care of themselves. They hold out larger prizes, but one must run faster to secure them.

And here we must leave the subject. We have pointed out one or two directions in which it is possible, with the longer experience now available, that mistakes have been made. But it is proverbially easy to be wise after the event, and on the whole, we may be excused for indulging in some feeling of pride in respect to the progress that has been made during the last 50 years. It is an encouragement to renewed effort for the future. In the words of one of your grand poets:

"Let us then be up and doing, with a heart for any fate,
Still achieving, still pursuing, learn to labor and to wait.
Not enjoyment, and not sorrow, is our destined end or way,
But to act that each to-morrow finds us further than to-day."

Gas Coals of America.

[Prepared by Mr. James D. Perkins, New York City.]

The records of the earlier gas companies in the United States indicate that illuminating gas was first made from *other* material than bituminous coal. In 1802 the City of Richmond, Va., had been lighted by gas made from wood. Whale oil was used in the New York City Gas Works in about 1825, to be superseded by resin soon after that date. This latter article found a place in nearly all of the older gas works in the country, down to 1850, being used not only alone, but as an enricher for coal gas.

The Baltimore (Md.) Gas Company was organized in 1817, resin and foreign coal, probably Newcastle, being used in the works of that company. There is no doubt that *American gas coals* were first used in these works, the coal being known as "Clover Hill," and it came from the Midlothian region, near Richmond, Va.; the date of its introduction is not known, probably as early as 1820.

Coal was first used in the Philadelphia gas works in 1836. This was domestic coal from the Pittsburg district, and was of the same general character as that now produced from that region.

Resin and foreign coals were the materials used in the Manhattan gas works, New York City, in 1835 and 1837. The foreign coal was the well known Newcastle, which was much esteemed for its freedom from sulphur and other impurities, although the *quality* of the gas produced was far below the standard of the present day, being only about 14 candles; hence the necessity of some enriching material, which acounts for the use of resin. American coal first appears on the records of the Manhattan Gas Company, in 1850, under the general name of Virginia coal, and was no doubt the "Clover Hill" referred to above.

The Boston Gas Company was organized in 1822, being the pioneer gas company of New England. Newcastle coals were the standard gas coals in England at that time, and it was from this source that the Boston company received its supplies for many years.

Prior to 1830 the gas industry was in its infancy, and its requirements had scarcely assumed the proportions of a distinctive feature in the manufacturing enterprises of the time. Some idea of the insignificance of this business may be gathered from the following item which appeared in the "Boston Almanac," of 1837, 15 years after its incorporation. Speaking of the city gas works, it says:

"The gas made at this establishment is a compound of coal and resin, and is esteemed for its brilliancy and illuminating power. There are three gasometers connected with the company's works, two in Hull street, each of 40 feet in diameter, and one in Washington street at the extreme south part of the city, of 80 feet. This is *the largest gasometer* in *the United States* and contains *fifteen thousand* cubic feet of gas. The roof over this building spans one hundred and two feet and rests entirely upon the walls without any support in the center."

Compare this holder of 70 years ago with the one recently erected at Astoria, which has a capacity of *fifteen millions* cubic feet of gas! No better illustration can be furnished of the tremendous progress that has been attained in the science of gas manufacture than is found in the comparison between the holder of 1837 and the works of that date, with the magnificent, perfectly appointed establishment at Astoria, representing every department of modern improvement in gas manufacture.

Discovery of Coal in America.

The existence of bituminous coal in the United States was first made known in a report by Father Hennepin, the Jesuit pioneer, in 1698, in which report he refers to coal deposits in Illinois near what is now Peoria.

In 1763, after a lapse of 60 years, further evidence of the existence of coal in the United States was furnished by Col. Cregan, a prisoner in the hands of the Indians. This coal was located on the banks of the Wabash in Indiana. The character of these coals must be left to conjecture.

Pennsylvania Gas Coals.

In 1770 came the discovery of coal in Western Pennsylvania. The only line of communication with that section of the country from the East was over the road traveled by General Braddock, on his ill-fated expedition, which had for its object the capture of Fort Pitt, the present site of the City of Pittsburgh, and it was along the line of this road that the first attempts were made to develop what is now familiarly known as the "Pittsburgh Seam" of bituminous coal; probably the most extensive deposit of gas coal to be found in this country, underlying five of the largest counties in Pennsylvania, and extending over an area of more than 2,500 square miles.

It was not until 1850 that any attempt was made to reach the Atlantic seaboard with these coals, the market in that direction having long been held by the Newcastle and Provincial gas coals, to the exclusion of supplies from other sources. The Boston gas Company had been in operation since 1822, but its management did not favor the use of American coals. On one occasion, when the question of imposing a duty on Provincial coal was before a Congressional Committee, Mr. W. W. Greenough, then and for many years the manager of the company, announced that the legitimate source of supply of coal for New England was from Nova Scotia, and that, *"If the Creator had intended his company to use the Pennsylvania coal, He would have placed them east of the Allegheny Mountains."*

One of the earliest (if not the first) companies formed to develop the resources of Western Pennsylvania was the Westmoreland Company; this was in the early fifties; the Penn Gas Coal Company followed two years later.

It may be of interest to quote the prices obtained for gas coals 35 years ago. In 1872, when there was a sharp competition for the trade, contracts were made at $6.87 for delivery in New York, and at $6 per ton f. o. b. Philadelphia for Eastern shipment. At the same time Provincial coals found a market in New York at $6 per ton. These figures were considered as being very fair by both seller and purchaser.

Owing to a strike among the miners, in the fall of 1872, the gas companies in New York and the east entered the spring of 1873 with much reduced supplies. Contracts for that year were made at $8.25, delivered, in New York, with Provincial coals costing $7.50, an advance of 25 per cent. over the previous year. From 1874 down, prices of the best gas coals delivered in New York and New England gradually declined, the result of the improvement in mining and the reduction in railroad transportation rates.

The success that had attended the operation of the Westmoreland and Penn companies soon led to competition from the owners of other gas coal properties in Western Pennsylvania. The Pennsylvania Railroad Company had enjoyed a practical monopoly of the gas coal carrying trade, until late in the seventies, when the Baltimore & Ohio Railroad made its first successful efforts to reach the New York and Eastern markets with the valuable gas coals located in Western Pennsylvania, utilizing what was then known as the "Connellsville Branch," a subsidiary of the Baltimore & Ohio Railroad. This road extended from Connellsville to Pittsburgh, a distance of 57 miles, following the course of the Youghiogheny River, which gave its name to the gas coals of that district.

The Youghiogheny River enters the Monongahela 15 miles southeast of Pittsburgh at McKeesport, which point is the northwestern limit of the Youghiogheny coal fields; following the course of the river southeasterly to Smith Mills, 37½ miles from Pittsburgh, the other limit of this particular coal deposit is reached. Within these two points, covering a distance of 16 miles in an air line, is *contained all there is* of the celebrated *Youghiogheny gas coal.*

The Waverly Coal Company, which mines were located near Newton, 37 miles from Pittsburgh, were the pioneer shippers of Youghioghney coals eastward, their first shipments to tidewater being made in 1873. These shipments gave such satisfaction that, when the contracts for 1874 were entered into, many of the Eastern purchasers divided their orders between the Youghiogheny gas coals and those shipped over the Pennsylvania Railroad. During the first two years of its operation this coal was shipped to nearly 20 gas companies in New York and New England. This serious encroachment upon the business of the Westmoreland and Penn Gas Coal Companies led to an agreement between the Baltimore & Ohio and the Pennsylvania Railroad Companies, under which the Waverly coal was withdrawn from the Eastern market, leaving that territory in the undisturbed possession of the Pennsylvania interests, but only for a brief period.

About 1878 Mr. W. L. Scott, of Erie, became the owner of the property which, up to that time, had been operated by Mr. Thos. Moore. The coal had a high reputation among gas coal purchasers, but its shipment eastward had been very limited, and practically to New England points. It was familiarly known at the time as "Moore's coal," located at what is now known as Scott Haven, 28 miles southeast from Pittsburgh. This coal Mr. Scott designated as the *"Ocean Mine Youghiogheny gas coal."* During a temporary scarcity of the Westmoreland and Penn coals, in 1880, and the inability of some of their customers to secure their usual supplies, several cargoes of the Ocean Mine coal reached the New York market, and it gave such marked satisfaction that, during the fall and winter of 1880-1, some 50,000 tons were taken by the New York gas companies. The following year it successfully competed with the other Pennsylvania gas coals for the New York and New England trade and was soon recognized as the standard American gas coal, which position it still maintains.

In 1899 this property was taken over by the Pittsburgh Coal Company, which had been incorporated for the purpose of bringing under one management the large number of individual companies that had been operating gas and steam coal mines in Western Pennsylvania.

The export of Pennsylvania gas and steam coals to Canada has steadily increased in recent years. The port of Kingston had for many years been considered the most eastern point in Canada which could be reached by American gas coals in competition with Provincial coal; but increased transportation facilities, and a growing conviction on the part of Canadian purchasers of the superior quality of the American product, have removed this limit, and contracts were made this spring for Pennsylvania coals, for 1909 delivery at Montreal, and as far as Quebec, at prices heretofore considered impracticable, and this notwithstanding the Canadian duty on the imported article.

The Berwind-White Coal Mining Co. having opened their gas coal property at Herminie, on the line of the Pennsylvania Railroad, became an important factor in the New York market, to which its product is mainly confined. Its character is identical with the Penn and Westmoreland, and is known in the trade as the "Ocean-Westmoreland gas coal."

In recent years some very good gas coals have been produced from the Saltsburg region, and from operations on the line of the Pittsburgh & Rochester Railroad, the production being used to supply local demands.

West Virginia Gas Coals.

The first American coal used for gas manufacture in the United States undoubtedly came from deposits on the line of the Baltimore & Ohio Railroad in Virginia and West Virginia. Lack of proper railroad facilities delayed the development of these coals until 1855, when the Newburgh Orrel was supplied to the Baltimore Gas Company, the owner of the property. During the six years preceding the Civil War considerable quantities of this coal, and that from other operations in the vicinity, were supplied to the New York gas companies. In 1861 the Government took possession of the Baltimore & Ohio Railroad for service as a military railroad, causing an entire suspension of coal shipments over that road for nearly five years. During this period the rapid development of the coal mines on the line of the Pennsylvania Railroad had been going on, and when, in 1865, the West Virginia gas coals were again available, the New York and New England markets had, to a large extent, been secured by the Pennsylvania coals, and the latter's only competitor, the Provincial coals.

In their efforts to regain the lost business the West Virginia operators labored under serious disadvantages. While the equipment of the Pennsylvania Railroad had been kept up to meet the increased demand for coal, the Baltimore & Ohio Railroad had suffered from the ravages of war and was in no condition to attack with any degree of success the superior facilities of its competitor. It had the further disadvantage also of having but one terminal at tidewater, Baltimore being the only port from which vessel shipments could be made. To secure minimum water freights it was necessary that shipments should be made in large vessels, and it was not always convenient for purchasers to receive such shipments; there was also the uncertainty as to time of delivery as well as of serious interruptions from ice in the winter months, when the coal was most needed. These difficulties continued until 1897, when arrangements were made with connecting railroads by which coals from over the Baltimore & Ohio Railroad could be shipped all-

rail to St. George, Staten Island, and Port Reading, N. J. With these added facilities a marked increase in the volume of business in these coals has been manifested.

Besides the Newburgh Orrel mine already referred to, shipments were made from several other operations in the same vicinity, among which may be named the Marion, Montauk, Montana, Fairmont Murphy Run and Despard. These different operations have recently been brought under one management, the Fairmont Coal Company, thus simplifying the business by the removal of the competition which had previously existed under individual management.

The West Virginia gas coals have always labored under the disadvantage of containing an excessive percentage of sulphur, rendering the purification of the gas expensive as compared with that from the Pennsylvania coals; but improved methods of manufacture have overcome this objection to a great extent. There still exists, however, in the minds of many gas engineers a disposition to avoid storing these coals in large quantities on account of possible deterioration in quality.

The Federal Coal Company, operating an extensive property in West Virginia, has recently come under the control of the Massachusetts Gas Company, who will eventually draw their entire supplies from that source.

The operators in the West Virginia region enjoy one advantage over their Pennsylvania competitors, in that they are exempt from many of the unsatisfactory conditions arising from the control which the labor unions undertake to exercise over the miners. The organization has no footing among the West Virginia miners, with the result that strikes in that region are comparatively unknown.

Clinch Valley Gas Coals.

The completion of the Clinch Valley Division of the Norfolk & Western Railroad, in 1892, opened up to the gas companies of the Atlantic Coast a new source of coal supply. The first shipments of gas coal from this district were made in November, 1892, but it was not until the spring of 1893 that the operations were in a position to supply any large quantity of coal; during that year about 60,000 tons of this coal were shipped to New York and the New England markets, giving general satisfaction. The position of this coal in the market was held until 1897, when the business gradually declined as the result of the comparatively high transportation rates as compared with those of other coal companies reaching Atlantic tidewater points at Philadelphia and Baltimore, and all-rail to South Amboy and Staten Island. The prospect of the return of these coals to the Northern markets for gas manufacture cannot be considered as promising.

Kanawha Gas Coals.

In 1873 the Chesapeake & Ohio Railway Company undertook the development of the gas coals located in Kanawha County on the line of their road, and several operations were opened up under their management.

Purchasers of gas coals were ready to welcome any new competitors to the Pennsylvania and West Virginia Companies, which, up to that time, had enjoyed a practical monopoly of the New York and Eastern markets for American gas coals. Under the paternal care of the railroad company transportation facilities were provided for reaching tidewater without much regard for the financial interest of the stockholders of the railway company, with the result that large quantities of the Kanawha coal reached tidewater at Richmond and Newport News, from which ports vessel transportation was available to any point on the Atlantic Coast.

With the advent of new management of the railway company, the support which had been granted the operators of these collieries was withdrawn, followed by a gradual decline in the entire business. River navigation to the West and Northwest still enables the coal to share to a limited extent in the trade in that direction. The character of the coal was not such as to commend itself to consumers, except at prices below those obtainable for the Pennsylvania and West Virginia product.

Provincial Gas Coals.

The existence of the immense coal deposits of Nova Scotia and Cape Breton was first made known in a French work, published in 1672, by the then Governor of Cape Breton, Nicholas Denys. In 1654 that official was granted a concession by the French Government to "Search for and work all mineral deposits of the Island."

Under this grant some trial shipments of coal were made to France, but no systematic efforts were made to develop these valuable deposits until about 1720, when the celebrated Fortress of Louisburg was being erected by the French Government; the fuel necessary for the large force employed in this work was obtained from a coal seam on the north side of Cow Bay. In 1724 a vessel was reported as having *"loaded coal at Cow Bay for Boston,"* but the bulk of the product for the next 30 years appears to have been limited to the wants of the Fort at Louisburg and an occasional shipment to Halifax.

In 1826 a lease was granted by George IV. to the Duke of York for the working of all the mines and minerals of Nova Scotia, which at that time included the Island of Cape Breton. As that nobleman had neither the means nor the ability to work the mines on his own account, he transferred the lease in 1827 to a company, which had recently been organized in London under the name of "The General Mining Association."

The only *gas coals* available to this Association were those from the Albion mines at Pictou, and the Lingan mines in Cape Breton. As the latter were not operated until 1855, the Albion was the only Provincial gas coal obtainable prior to that date.

The records of the Association give the annual shipments of this coal to the States, but as a large percentage of the quantity reported was used in iron manufacture and foundry purposes, it is difficult to form any reliable estimate of that which entered into the manufacture of gas. It was used in the Boston works, in 1838, and continued to form part of their supplies from that time forward until 1875, when its use was abandoned by that company.

The same energetic, far-seeing business man, who had organized the first regular steamship line between Liverpool, Halifax and Boston, in 1840, the Hon. Samuel Cunard, was then at the head of the "General Mining Association." Visiting Boston in 1845, he placed the agency for the sale of the coals controlled by his company in the hands of Mr. James P. Melledge and Mr. Thomas Tremlett, two well-known merchants of Boston; names familiar to the gas-making fraternity of 50 years ago.

The facilities for the conduct of the business at that time were extremely primitive. Navigation between the mines and the New England ports was only possible between May and December, the Straits of Canso being closed by ice during the remainder of the year. The vessels employed in carrying the coal were small, carrying from 80 to 120 tons capacity, and mainly owned and sailed by French residents in and about Arichat, Cape Breton. In later years, as the demand for this coal increased, notably during the Civil War, a larger class of vessels was introduced, carrying from 800 to 1,200 tons; these were built at and near Pictou, and their construction and employment gave to that place a position among the most prominent maritime ports in the Provinces.

Vessel freights to Boston during the shipping season ranged from $1.50 to $2.25 per ton, and down to a period just prior to the war the average cost of this coal, delivered in Boston, varied but little each year from $4.25 to $4.75 per ton. The Albion coal yielded about 8,000 cubic feet of 15-candle gas. Being almost entirely free from sulphur, its purification was comparatively easy; a consideration having much greater weight 50 years ago than at the present time.

About 1850 efforts were made to secure a share of the New York market for the Albion coal, but were unsuccessful; the few cargoes sent to that port did not give satisfaction as compared with Newcastle coals, which had always been a favorite with the gas companies in that city; but considerable quantities were sold to the gas companies then in existence on the Sound, notably at Providence, Newport and Fall River.

During the decade of 1850-60 a number of new gas companies were formed in New England, mainly around the vicinity of Boston. Among these may be noted Worcester, Cambridge, Charlestown, East Boston, South Boston, Dorchester, Chelsea, Jamaica Plain, Newton and Fitchburg. The first coals used by these companies were from the Albion mines at Pictou. During this period the Lingan mines were opened by the Association. This coal at once became a favorite with the gas companies of New England, as well as New York; a gross ton yielding 9,500 cubic feet of 16-candle power, taking the place in many instances of the favorite Newcastle coals.

The year 1858 brought with it a most important change in the conduct of the Provincial coal trade. Down to that period the entire control of all the mineral deposits in the Province was vested in the General Mining Association. In this year an agreement was entered into with the Colonial Government by which the lease of 1828 was abrogated. This arrangement threw open at once to private enterprise large areas of mineral property which otherwise must have remained for many years undeveloped.

The local government at once received numerous applications for

leases to work some of the most promising of these deposits, and it was under the management of the parties receiving these grants that some of the most sucessful collieries in the Provinces were subsequently conducted. These new enterprises had scarcely been placed in working condition, when the events of 1861, suspending for several years the operations of some of the larger collieries in the States, gave the Provincial coal trade an impetus which called for the exercise of all the resources at the command of its managers. From 1861 down to 1870, it was not so much a question of prices as it was of ability of the coal companies to meet the pressing demands for coal, not alone from gas companies, but for general steam and manufacturing purposes.

In addition to the Albion and Lingan collieries, to which reference has already been made, there were five collieries in the Provinces, opened up by private enterprise, from which the gas companies in the States drew a large part of their supplies during the 12 years from 1858 to 1870. Reference is made to these operations in the order in which the applications were granted:

Little Glace Bay Mines, Little Glace Bay, C. B.—This lease was given to Mr. E. P. Archbold in 1858.

Block House Mines, Cow Bay, C. B.—Lease granted to Marshal Bourinot, 1859. Operations commenced in 1860 upon the site from which coal had been mined in 1766, nearly 100 years previous.

Gowrie Mines, Cow Bay, C. B.—Lease granted to Messrs. Archibald & Co., 1861.

Caledonia Mines, Port Caledonia, C. B.—Mining operations commenced in 1865, under the management of Messrs. J. H. Converse, Estes Howe and others of Massachusetts.

International Mines, Bridgeport, C. B.—The larger part of the product of this colliery in its most prosperous days was sent to New York. Various causes, partly incident to the management and in part to the quality of the coal as compared with other Provincial coals, led to its early abandonment by the gas companies in the States.

The Gowrie coal came into the market as a gas coal, and found limited sale for that purpose in the early days of its operation. The unsatisfactory quality of the coal, and the condition in which it came to market, soon led to its early abandonment for gas purposes.

The coal from the Glace Bay and Block House mines came into the market at a time when the demand for gas coal in the States was very active. No difficulty was experienced in finding sale for all these collieries could produce. The Glace Bay was distributed among the leading gas companies between Portland, Me., and Washington, D. C., the Capitol being lighted by gas from that coal in 1863. It was also used at Fortress Monroe, when General Butler was in commmand at that station. The Northern Liberties Gas Company, Philadelphia, purchased a large part of their supplies from Glace Bay during the war, and immediately thereafter. The price during the early years of its operation was $2.40 gold per ton of 2,240 pounds, f. o. b. vessel at the mines; and in 1863 and 1864 the company sold its entire product at the opening of the season at that price. This coal was a favorite one with the New York companies, and shared the trade in that market in nearly equal proportion with the Block House, supplying at the same time a larger part of the gas coals required in New England.

The Block House colliery enjoyed a most prosperous trade with the States from 1861 down to 1873. The bulk of its product went to New York, where it easily commanded $2.60 gold per ton of 2,240 pounds f. o. b. vessel, during the early years of its operations. The mine was worked out in 1885.

The Caledonia mines went into active operation in 1868, and in the demand for coal following the opening of the colliery, it succeeded in getting a strong footing in the market, reaching a maximum output of over 75,000 tons in 1873. From that date forward, it shared in the general decline of all Cape Breton coals in the United States.

It would be difficult to give the cost of these coals in detail to the consumer during the period of their most active sales. The purchaser paid for the coal in gold at the mines, and assumed all the additional items entering into its transportation to the point where it was required; the fluctuations in the premium on gold varying at times from 5 to 20 per cent. in one day, and from 20 to 50 per cent. during the year, renders it impracticable to give any reliable quotations for these coals in the States prior to the resumption of specie payments.

Sales were occasionally made in 1865 at $14 U. S. currency, per ton delivered in New York, and these figures no doubt represent the *maximum* cost of any of the Cape Breton coals in the States at any one time. This item represented say $2.50 gold per ton as the cost of the coal at the mines, and a vessel freight varying from $6 to $8 per ton U. S. currency.

So heavy was the strain upon the capacity of the collieries during that period that it was no uncommon event for vessels to wait four or five weeks for their turn to load; this delay in securing cargo had much to do with the high freight demanded at that time. The close of the war, and the removal of the disabilities which had during that time rested upon American vessels, the opening up of other sources of coal supplies, and consequent decrease in the demand for Provincial coal, led to a gradual falling off of the trade and subsequent elimination of these coals from the United States markets.

A large degree of the prosperity of the Provincial coals in the United States markets was no doubt due to the existence of the Reciprocity Treaty, which continued in force until 1867, giving these coals free admission into the States from 1854 to 1867, including the period of the Civil War. The abrogation of that Treaty, in 1866, subjected Provincial coals to a duty of $1.25 per ton, payable in gold, which was still held at a premium. The effect of this tax was seen in the decrease of importations in 1868 of nearly 100,000 tons, or about 20 per cent., less than for the previous year. The annexed table shows the shipments of Provincial coal to the States, from 1850 down to 1886, inclusive; the quantities named therein include shipment for other purposes as well as for gas coal trade for those years:

PROVINCIAL COAL EXPORTED TO THE UNITED STATES.

Years.	Tons.	Duty.	Years.	Tons.	Duty.
1850	118,173	24 ad.	1869	257,485	$1.25
1851	116,274	24 ad.	1870	168,180	1.25
1852	87,542	24 ad.	1871	165,431	1.25
1853	120,764	24 ad.	1872	154,092	.75
1854	139,125	Free	1873	264,760	.75
1855	103,222	"	1874	138,335	.75
1856	126,152	"	1875	89,746	.75
1857	123,335	"	1876	71,634	.75
1858	186,743	"	1877	118,216	.75
1859	122,720	"	1878	88,495	.75
1860	149,289	"	1879	51,641	.75
1861	204,457	"	1880	123,423	.75
1862	192,612	"	1881	113,728	.75
1863	282,775	"	1882	99,302	.75
1864	347,594	"	1883	102,755	.75
1865	465,194	"	1884	64,515	.75
1866	404,252	"	1885	34,483	.75
1867	338,492	$1.25	1886	60,646	.75
1868	228,132	1.25			

The above table is from the "Report of the Department of Mines, Nova Scotia, for the Year 1886."

Another table gives the comparative results obtained for the best known American and Provincial gas coals. This table was prepared from the records of a leading gas company, in whose works both descriptions of coal had been largely used prior to 1876:

	GAS.				COKE.			ANALYSIS OF COAL.				
Name and Location of Mine.	Feet per Ton, 2240 Standard.	Maximum yield per ton of 2240.	Candle Power.	Specific Gravity. Air 1.000.	Bushels of Coke per Ton of 2240 Coal.	Pounds of Coke per ton of Coal.	Specific Gravity of Coal.	Per Cent. of Volatile Matter.	Per Cent. of Fixed Carbon.	Per Cent. of Ash.	Per Cent. of Sulphur.	Per Cent. of Water.
Average result obtained from the Standard American gas coals from western Pennsylvania, viz.: Westmoreland, Pa., and Youghiogheny	9500	11800	16.50	0.450	42	1600	1300	33.80	56.99	6.52	1.19	1.50
Average result obtained from the leading Cape Breton gas coals, viz.: Block House, Glace Bay, Caledonia	9500	10800	15.60	0.447	34	1570	1285	35.25	53.18	5.50	3.01	3.06

The coke produced from the American gas coals herein named is a most excellent article for house and general use, but not so strong for use under the retort as that obtained from the Cape Breton coals, or from some of the sulphurous gas coals obtained from Western Virginia. Those gas companies whose facilities for purifying are ample prefer to have from one-fourth to one-third of their coal from either Cape Breton or Western Virginia, in order to get a stronger coke than the standard Pennsylvania coals afford.

It will be noticed that the American coals produce 20 per cent. more coke than the Provincial coals—a very important item when it is considered that from 50 per cent. to 60 per cent. of the coke made is sold by the bushel for house use.

Sulphur.—One bushel of hydrate of lime will purify about 5,000 cubic feet of gas made from American coal, and about 2,500 cubic feet of gas made from Provincial coal.

In a paper which the writer had the honor to prepare for the American Gas Light Association, and which was presented at the meeting of that Association, held at Toronto, in 1888, the following statement occurs:

"It is scarcely possible that Provincial gas coals will ever regain the position occupied by them during their most prosperous years."

One of the reasons given for this opinion was the great disadvantages they are under in competition with American gas coals, restricting economical importation to about eight months in the year, and further the gradual reduction in the delivered cost of American gas coals in New England, arising from improved rail and water transportation from the American collieries to that market.

In 1893 the Dominion Coal Company was organized by Mr. H. M. Whitney, of Boston, to take over the Cape Breton coal mines, which had then recently been purchased by him. The attention of the new management was at first directed to the improvement of the facilities for the delivery of their coal in the Canadian market; this accomplished, it was then decided to attempt the regaining of the New England trade. This was done through "The Massachusetts Gas Companies," a corporation which had then recently taken over the following companies:

The New England Gas & Coke Co.,
Boston Consolidated Gas Co.,
East Boston Gas Co.,
Chelsea Gas Light Co.,
Citizens' Gas Light Co., of Quincy,
New England Coal and Coke Co.

In addition to the above, the Boston Consolidated Gas Co. controlled the gas companies of Brookline, Roxbury, Jamaica Plain, Dorchester and South Boston.

A long term contract was entered into between the Dominion Coal Company and the New England Gas & Coke Company when Mr. Whitney was in control of both of these companies. Under this contract the latter was to use Cape Breton coals in the extensive gas and coke plant erected at Everett, near Boston, Mass. The Cape Breton culm was at first used in these works. Their process contemplated the manufacture of gas, coke and ammonia sulphate, in connection with the "Otto" oven. The gas produced was of very poor quality (only about 11 candle power, subsequently enriched from water gas), and was supplied to the various gas companies in the vicinity controlled by that company. A large quantity of coke was produced and strenuous efforts put forth to market it among the railroad companies and steam users in New England, but with limited success, owing to its inferior quality. It was also specially prepared for domestic purposes and with like unsatisfactory results.

The Massachusetts gas companies have recently purchased the "Federal Mines," a large gas coal property in West Virginia referred to above, it being their announced intention to secure all their supplies from that source as soon as the contract with the Dominion Coal Company expires; thus terminating what had proved to be an unfortunate attempt to reinstate the Cape Breton coals in the New England market.

Anthracite Gas Coal.

Following the discovery of petroleum, in 1859, repeated attempts had been made to utilize its products in the manufacture of illuminating gas, but it was not until 1876 that these efforts were attended with any degree of success. In that year the Municipal Gas Company entered the field with a so-called "water gas plant" to contest with the then existing coal gas companies for a share of the gas business of the country.

Their plant was erected in New York City, and was operated under the "Tessie du Motay" system. Installed in 1876, it has been in continuous operation down to the present time, and with a marked degree of success.

It was the first water gas plant of any considerable size erected in this country. Its construction and installation were the work of Mr. William H. Bradley, then connected with the Continental Iron Works, of Brooklyn, N. Y., and now the Engineer-in-Chief of the Consolidated Gas Company of New York.

The gas was produced from a combination of anthracite coal and naphtha, it being the first instance on record of the use of these combined materials for the production of illuminating gas.

The circumstances attending the introduction of the new method of gas manufacture were peculiarly favorable for the successful prosecution of the enterprise. The price of gas in New York was $2.50 per 1,000 cubic feet, a highly remunerative one for the then existing companies. The conditions as to candle power to be furnished to consumers, permitted the companies to use the American bituminous gas coals then obtainable, with but a very small percentage of enriching cannel, to produce an 18 candle gas, which gave perfect satisfaction.

With such a combination of materials as was employed in the water gas plant, the latter could supply the field with a gas of from 24 to 30 candles (an advantage which the public were quick to appreciate, and not slow to avail of). A slight reduction in the price from $2.50 to $2.40 per 1,000 cubic feet by the new competitor led to a most serious encroachment upon the field which had so long been occupied by the coal gas companies.

The successful operation of the "Tessie du Motay" process by the Municipal Gas Company led to the adoption of this system by other gas companies in New York and elsewhere. The New York Gas Company, the pioneer company of New York, changed its entire plant from coal gas to water gas in 1881. The extremely low price of the material used in the new plant was a powerful inducement to make the change, naphtha being about 1½ cents per gallon and anthracite coal from $2.90 to $3 per ton.

The extended use of water gas as a competitor to the old method, and the inroads that the former interests were making upon the business of the coal gas companies, soon brought about one of the most bitter contests ever known in the gas industry. The price of gas to consumers rapidly declined from $2.50 to 75 cents per 1,000, and in some cases even lower figures were named, either to hold existing customers or capture others from competitors. The unprofitable result of this contest was soon recognized, and an arrangement entered into by which the interests of both parties were secured from further useless sacrifices. The successful working of this arrangement led to the union of all the companies interested under one management, the present Consolidated Gas Company of New York City, organized Nov. 11, 1884.

The future of water gas must necessarily depend upon the continued production of petroleum and anthracite coal at a moderate cost. The sections of the country from which these supplies are now available is comparatively limited and may in the not distant future be affected by causes beyond human control. On the other hand, the coal gas companies are free from any anxiety as to the probable failure of supplies for the operation of their plants. As set forth elsewhere in this paper, the deposit of bituminous gas coal is practically unlimited, and will be available for generations to come at a cost that will justify its utilization for gas manufacture.

Welsh Anthracite Coal.

While not entitled to be classed as one of *the "gas coals of America,"* this coal was such an important factor in the gas coal market during the prolonged strike of 1902-03 as to warrant brief consideration in this article.

The coal strike in the anthracite regions, which began with the cessation of mining in the spring of 1902, and which continued for nearly one year, brought the water gas companies face to face with one of the most serious problems which had ever been encountered in the history of the gas industry. In the expectation that the strike would be of but short duration no steps were taken to secure a substitute material until after midsummer, when the situation became too serious to admit of longer delay. In looking about for supplies to tide over their difficulties, recourse was had to the anthracite deposit in Wales, England; the general character of which coal was pretty well known here, sample parcels having been brought to the New York market in the early days of water gas, and it had been used to some extent by the gas companies on the Pacific Coast.

Negotiations looking to the importation of this coal were be-

gun in the late summer of 1902, with the result that the New York gas companies secured some 80,000 tons of this material. Its cost, laid down at New York and other Atlantic seaports, ranged from $7 to $10.50 per ton, the earlier purchasers securing considerable supplies at the minimum figures.

As the demands increased with the waning hopes of any settlement of the strike, prices correspondingly increased, and importations continued until the spring of 1903, when it became apparent that the home product would soon become available.

It would be difficult to form a correct estimate of the pecuniary loss entailed upon the gas companies of the country as the result of their voluntary action in the matter; but it would not be far from one million dollars, while the direct benefit to the public, as the result of the action of the gas companies, cannot be compiled in dollars and cents.

Experience in the use of Welsh anthracite coal during the strike demonstrated that, under favorable conditions, it was well adapted for the purposes of water gas production. It was found to be practically free from impurities, but it was open to one serious objection, viz.: Its friability causing a very large percentage of fine coal when shipped in large quantities, and subject to repeated handling, as was the case with the recent importations to this country, resulting in from 25 per cent. to 30 per cent. of slack coal not available for use in a water gas plant.

It is to the credit of our local gas engineers that they were able to meet the conditions that confronted them during the troublesome period of the strike with such marked degree of success. The experience thus secured is not likely to be forgotten soon by them.

Enriching Coals.

Albertite, of New Brunswick.—For a period of nearly 30 years, from 1852 down to 1881, this mineral stood at the head of all the then known materials for the enriching of coal gas.

The earlier shipments were used in the works at Boston, but upon the introduction of kerosene oil manufactured from shale and cannel coal, a large portion of this product was devoted to that purpose. The discovery of petroleum, in 1859, however, put an end to the distillation of oil from cannel and similar material, and Albertite resumed its place as an enricher of coal gas. Its use in later years was almost entirely confined to the Boston gas works.

Its value for gas purposes has been variously estimated as from $22 to $25 per ton. The deposit was exhausted in 1881, and all attempts to locate other deposits of a similar character in that vicinity have so far been unsuccessful.

Ritchie Mineral.—Resembling somewhat the Albertite, but inferior in quality, this material was used to a limited extent by some of the gas companies in the interior. It was a "pocket" deposit located in Ritchie County, West Virginia, but the supply was of short duration.

Breckenridge Cannel.—Nearly 60 years ago, February 9, 1855, the State of Kentucky granted a charter to the Breckenridge Cannel Coal Co., the object of the company being the distillation of illuminating oil from the valuable cannel deposit owned by the company. From one ton of the cannel there was obtained 140 gallons of crude oil. This valuable property was located at Cloverport, Ky., on the Ohio River, 110 miles westerly from Louisville.

Upon the discovery of petroleum the manufacture of oil was discontinued, and the colliery remained idle, until 1883, when operations were resumed for the purpose of putting the cannel on the market as an enricher of coal gas. A chemical analysis of the cannel showed:

	Per Cent.
Volatile matter	63.5
Fixed carbon	27.0
Ash	8.5
Sulphur	1.0

Considerable quantities were brought to New York, where it was readily disposed of at about $11 per ton. Large shipments were made to South America and other foreign markets, but the expectations of the owners of the colliery as to the available supply of the cannel were not realized, the deposit having been exhausted in 1892.

Peytona Cannel.—This cannel was one of the favorite enrichers of gas coal in the late '60s. Located in the mountains of West Virginia, it labored under the disadvantage of not being accessible by rail, the company being compelled to rely upon water navigation to reach the Chesapeake & Ohio Railroad at Charlestown, W. Va. This method of transportation was necessarily very uncertain, owing to droughts in the summer and obstructions by ice in the winter. Its yield of gas was about 11,000 cubic feet, of 38 to 40 candles. The mine was worked somewhat irregularly, until 1878, when the deposit became exhausted.

Cannelton Cannel.—Before the discovery of petroleum in 1859, this cannel was highly esteemed as an oil producer, and extensive works were erected on the property for the distillation of the cannel, yielding an average of 62½ gallons of crude oil per ton of 2,240 pounds. These works were rendered unprofitable by the competition from petroleum, and the extremely low price at which it could be furnished, and the distilling plant was abandoned, remaining idle until 1872, when it was introduced into the New York and Eastern markets as an enricher for coal gas.

Commencing with an output of 16,000 tons, in 1873, the production rapidly increased until it reached 40,000 tons in 1876. The first shipments sold as high as $16 per ton, delivered in New York. This price, however, could not be maintained in face of the English and Scotch cannels, and was gradually reduced until during the later years of the operation, it was $6.50, which quotation was held until the mines were exhausted, about 1880. During its brief existence the cannel was supplied to over 50 gas companies in New York, New England and the Middle Southern States.

O. K. Shale—O. K. Boghead.—Besides the Breckenridge, Kentucky has furnished other cannels specially adapted for the enrichment of illuminating gas, notably the "O. K. Shale—O. K. Boghead." Considerable quantities from these collieries having been exported to Europe, the local demand being restricted almost entirely to domestic use.

Jellico Cannel.—In 1888 Tennessee came into the market with a very excellent grade of gas cannel, an extensive deposit of the article having been then recently discovered at Newcomb, near Knoxville. The colliery was advantageously situated for reaching any of the points on the Atlantic Coast, and some heavy shipments were made at one time to New York, but its importance as an enricher of coal gas ceased with the extension of water gas plants in the United States.

Conclusion.

Whatever may be the future of the gas industry of the United States as the result of a more general use of electricity, for domestic purposes, bituminous gas coal will continue to hold its place as a necessary and important factor in the conduct of one of the greatest if not the greatest of industrial enterprises of modern times.

The utilization of residuals from the carbonization of gas coals, which has made such rapid progress during the past decade, has brought about the economical use of coke from bituminous gas coals as a prospective substitute for anthracite coal in water gas plants.

The wonderful discoveries of Sir William Henry Perkin, disclosing the value of the once despised coal tar, the extraction and distillation of ammonia, together with the recognized importance of the coal itself as a gas producer, combine to ensure for generations to come the increasing development of the unlimited deposits of The Gas Coals of America.

A Half-Century History of Water Gas.

[Prepared by Mr. F. N. Morton, Philadelphia, Pa.]

Early History and Retort Systems.—The foundation of water gas as we know it was laid by Fontana, who, in 1780, proposed to manufacture a gas by passing water over ignited iron and coal. Although Cavendish is generally accredited with the discovery of the composition of water, the suggestion of Fontana antedated this discovery by four years.

Following Cavendish's announcement, Lavoisier and Meunier made hydrogen by passing steam through a red-hot iron pipe. Then, reasoning that carbon possesses a considerable affinity for oxygen, they introduced charcoal in the pipe, making water gas, as did Fontana.

In 1817, the Gengembres, father and son, took out a patent in France, and, in 1819, a supplementary one, for making gas by the action of steam upon charcoal placed in retorts, the resulting gas being enriched by the simultaneous production of coal gas in the same retort.

In 1823, William Vere and H. C. Crane were granted patents for a process in which water or steam was passed into retorts in

which coal or oil was being distilled. From the wording of the specifications, however, it is questionable whether the patent was for a gas making process as much as to aid in the condensation of impurities and to prevent stoppages.

From the time of J. H. Ibbetson, who, in 1824, took out a

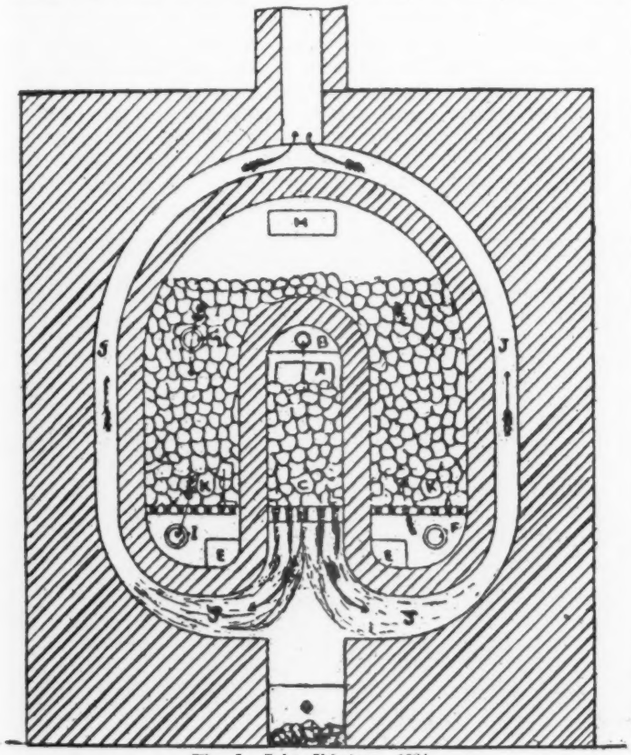


Fig. 1. John Ibbetson, 1824.

patent for admitting "Steam into the decomposing chamber when in operation, among the ignited coal or coke, alone or mixed with

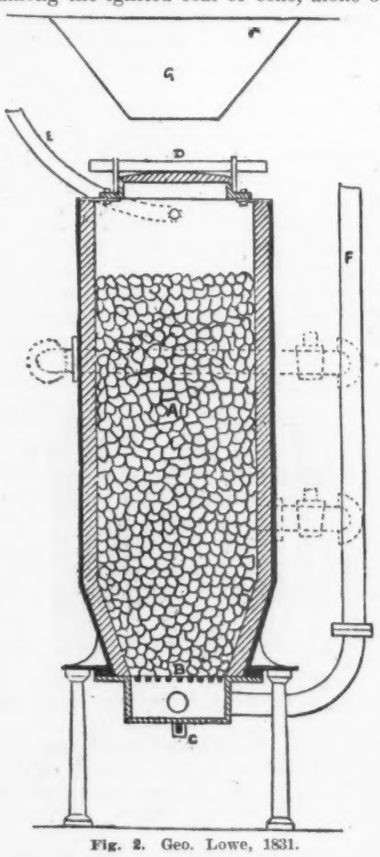


Fig. 2. Geo. Lowe, 1831.

tar or oil," patents for water gas apparatus followed thick and fast, a list of 60 being given in the American Gas Light Journal, for September 16, 1864. As is the way of inventions, few of these ever progressed further than the granting of the patents. Some, however, were tried practically; as, for instance, those of Donovan, Stephen White, Jobard and others.

Michael Donovan was the first to actually make and distribute water gas. In 1830 he employed it for public lighting in Dublin, Ireland, but without permanent success. His patent was for decomposing steam by passing over red-hot coke or charcoal, and carburetting by volatile hydrocarbons. It is to be noted that this is also the first attempt at making what is known as a carburetted water gas.

In 1831, Geo. Lowe, Engineer of the Chartered Gas Company, London, took out a patent for the first internally fired generator, as we now know it. This was to be placed where the hot coke from the retort would fall into it. The top and bottom doors being left open, heat was to be raised by the natural draft, after which, the doors being closed, steam was to be admitted at the top and the resulting gases taken off at the bottom, or else, by outlets at various heights, from the hottest portion of the fire. The gas was to be afterwards carburetted.

Selligue employed semi-cylindrical retorts, arranged vertically

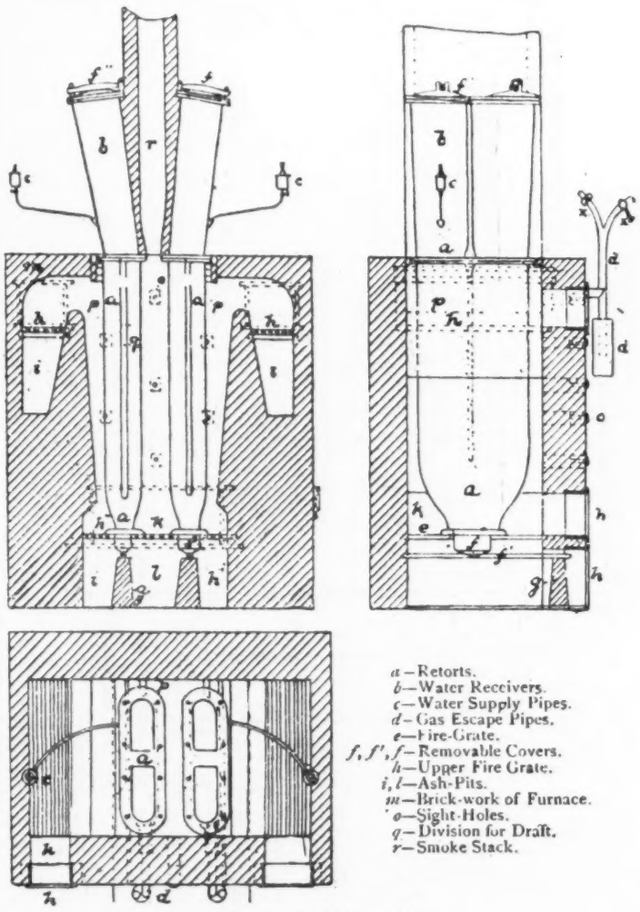


Fig. 3. A. Selligue, 1835.

in pairs, and heated by external firing from above and below by grates at two levels. The interior of each retort was divided into two compartments by a vertical firebrick partition. Water was admitted into the top of one chamber through which it passed downwards, undergoing partial decomposition, and then up through the second, rendering the decomposition complete. The gas then passed to a third cylinder, maintained at a red heat, in which shale oil was admitted in the proportion of 4 or 5 litres an hour, the production of gas per hour being 8,750 to 10,500 litres.

Jobard really seems to have been the inventor of this system, which he sold to Selligue for 10,000 francs and one-third the profits with the understanding that the latter should have the credit of the invention. The apparatus was installed in Dijon, Antwerp, Strassburg and Paris, and promised so well that Selligue was, on January 18, 1838, granted for it a prize of 2,000 francs which had for several years been offered by the "Societe d'Encouragement". Selligue was on the point of receiving also the cross of the Legion of Honor when it developed that he was not the

inventor, and he and Jobard were summoned before a commission.

In 1839 Val Marino patented an apparatus comprising three vertical, externally-heated retorts, all filled with coke or other material. Water was admitted at the top of the first and, passing down, was decomposed. The gases then passed upwards in the second retort, where they met oil or fatty matter, and, finally, down through the third retort and out. In the same year Alex. Cruikshank recommended first superheating the steam, and also producing illumination by the incandescence of platinum in the form of a ball or wire cage.

In 1846, J. P. Gillard received a patent for the manufacture of hydrogen, incorrectly supposed to be pure, by passing steam into a retort or cupola containing incandescent carbon. The gas was used for lighting in conjunction with a platinum basket or cage surmounting an argand burner. This system, which is interesting as foreshadowing the present incandescent gas light, was for several years used to light the streets of Narbonne and Passy. Gillard later appears to have substituted a vertical cupola for horizontal retorts, but the economy resulting therefrom was not sufficient to make it permanent.

Another system which was actually tried was that of Stephen White, who, in 1847, obtained a patent for his apparatus, and

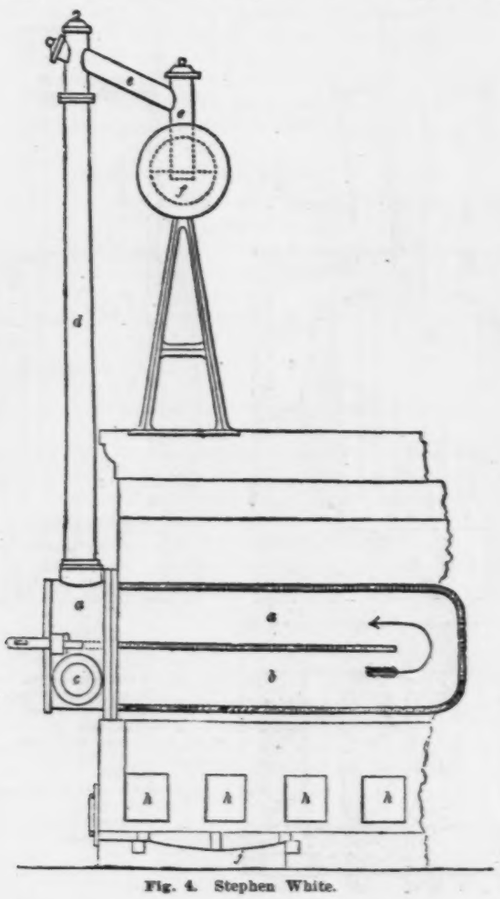


Fig. 4. Stephen White.

later introduced it in the towns of Ruthin, Southport, Warminster and Dunkeld, in many mills and factories in Lancashire, and in the South Metropolitan gas works, London. One of the mills in which the system was installed was that of Messrs. Clarke & Co., Manchester, where the proprietors had erected a small coal gas plant. The apparatus consisted of two horizontal and two vertical retorts. Resin was mixed with oil and melted in a small vessel outside of the building, and then siphoned into the horizontal retorts and decomposed therein. Water was siphoned into the vertical retorts and, entering the top, was decomposed by passing over charcoal and iron scrap at a high temperature. The gas thus produced entered the horizontal retorts and, passing through, became mixed with that from the resin and oil. Dr. Frankland and Mr. Clegg tested this plant and reported very favorably on the system; and it was said that the late Sir Geo. Livesey favored it; the expense of decomposition, the condensible character of the gas, the difficulty in regulating the steam and excessive wear-and-tear, however, prevented its being a success. In a modification of the system, cannel coal was used in the retorts instead of resin and oil, but the water gas was passed directly into the hydraulic main instead of into the coal gas retort, thus, in the words of Dr. Frankland, reducing "The advantageous operation of the water gas in rapidly sweeping out the illuminating gases from the coal retort". This is especially interesting as forestalling the modern idea of admitting water gas to coal gas retorts during carbonization, and also its associate "auto-carburetting". One form of this system is shown in the cut. Another system which was adopted about 1848 by the town of Mastricht and by some of the departments of the Vielle Montagne at Verviers, as well as by several industrial concerns at Liege, was that of LePrince, who used a single retort divided into three chambers of unequal capacity. The material for distillation was placed in the largest, and the coke for decomposing the water in the second, while in the third, the gases mix in the presence of coal.

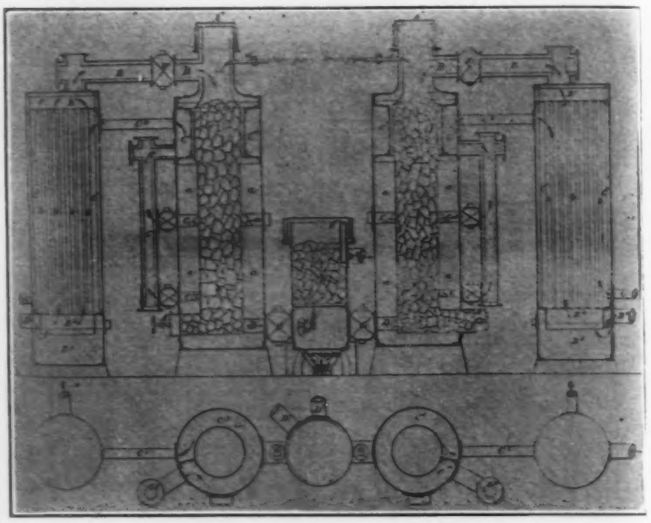


Fig. 5. Kirkham's Apparatus.

In 1852 and 1854, John and Thomas Kirkham took out patents, the second of which is shown in the accompanying cut. In practice the apparatus was built in a rectangular form. Natural draft was used and the products of combustion were heated by the blast products in the tubular heater, the air being admitted to the fuel bed at various heights as desired. During the run the steam was admitted at the top of the generator, and, passing down through the fuel bed was decomposed, the water gas passing to the small "mixing chamber" shown between the generators. Here it met a "gas rich in carbon", the object of the broken bricks being to thoroughly mix the two gases. This apparatus was erected in the Municipal Gas Light Company's works in New York.

In 1858, a process, invented by J. M. Sanders, for enriching water gas with resin gas, was tried in the Philadelphia gas works, and later in Wilmington, Del., Aurora, Ind., Laconia, N. H., and elsewhere. This apparatus, as will be seen, consisted of a bench of castiron, L-shaped retorts, which were filled with charcoal and

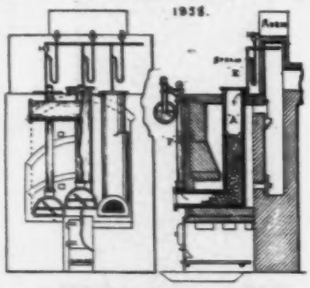


Fig. 6. J. M. Sanders.

brought to a high heat. Superheated steam was admitted at the top, together with melted resin, and, passing down through the charcoal, was decomposed. The gas was easily condensed; and this, with the excessive wear on the retorts, practically killed the system.

The next process to attract attention was the Gwynne-Harris, or, as it was called after the death of Mr. Gwynne, the Allen-Harris. This was patented in 1863, and in 1864 was experimented

with at Elizabeth, N. J. In 1873 it was introduced into the works of the Citizens' Gas Company of Brooklyn, N. Y., but, as at Elizabeth, it did not long remain in use. Between 1858 and 1875 it was almost the only water gas process that attracted public attention, and, largely owing to the energy of Mr. Allen, was the most persistent effort to make water gas in retorts. Besides Brooklyn and Elizabeth, plants were erected at Utica, Westchester, Rondout and Poughkeepsie, N. Y., Fair Haven, Conn., and Newark, N. J. A sketch of the Poughkeepsie machine is reproduced, showing the vertical retorts, which were filled with coal and into the top of which steam was admitted. The resulting water gas was then conducted to the bench of double retorts, whose front elevation is shown, where it mingled with the oil and was converted into a fixed gas. As erected in Brooklyn, the steam was superheated by passing through pipes in the bench, and through distributing tiles laid in the water gas retorts, which here were horizontal. The distributing tiles were perforated so that the very highly superheated steam escaped through the incandescent coal. The water gas was then conducted to the hydraulic main, to mingle with the coal or oil gas there, and was thus carburetted.

About 1873, W. D. Ruck brought out an apparatus consisting of three retorts one over the other. The retorts were charged with

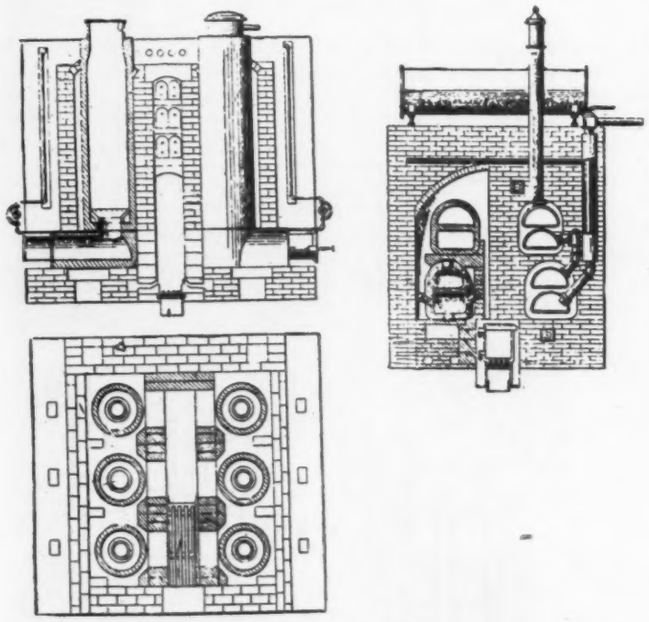


Fig. 7. Allen-Harris Apparatus.

a mixture of coke and iron; and steam, passing through an iron pipe in the setting to act as superheater, was then admitted to the back end of the lower retorts, through pipes in the latter, and then returned through the mass of coke and iron. The gas then traversed the third retort in the same manner. To render the gas illuminating it was passed through a chamber containing rectified petroleum spirit.

In the same year, R. P. Spice invented an apparatus comprising six vertical cast-iron retorts, filled with breeze and clinker. Steam was introduced at the upper end of the retort by a pipe extending nearly to the bottom. For carburetting the gas as produced, light petroleum spirit was employed. The cost of the process was said to compare favorably with that of coal gas; but the cost of coal was then high, and, with a reduction in price, all chance of success of the "new gas", as it was called, disappeared.

In 1875 and 1876, J. W. Beatley and J. P. Gill took out patents for mixing steam with oil vapors and putting the mixture through retorts, the former setting aside for the purpose one or more retorts in a coal gas bench. Beatley's process was installed in the Peoples' Gas Company, Brooklyn, where the inventor was engineer. It was not long used, however, and he and Gill joined forces and installed their combined system at Newark, N. J., where it, also, soon fell into disuse.

But one of the many retort processes seems to have been used for a considerable time, and that was the Slade, which was operated for six years (from 1883 to 1889) at the works of the Yonkers Gas Light Company, N. Y., by the inventor, who was the superintendent of the plant. The process was simple and consisted merely in the introduction of superheated steam and naphtha into the ordinary coal gas retorts charged with coke. The stream of steam and oil vapor was carried through a fireclay pipe on the bottom of the red hot retort to the rear end, where, issuing from the pipe, it returned over the bed of coke. One or two retorts were used for regular coal gas to supply coke for firing the benches. In a later modification, and the one shown in the cut,

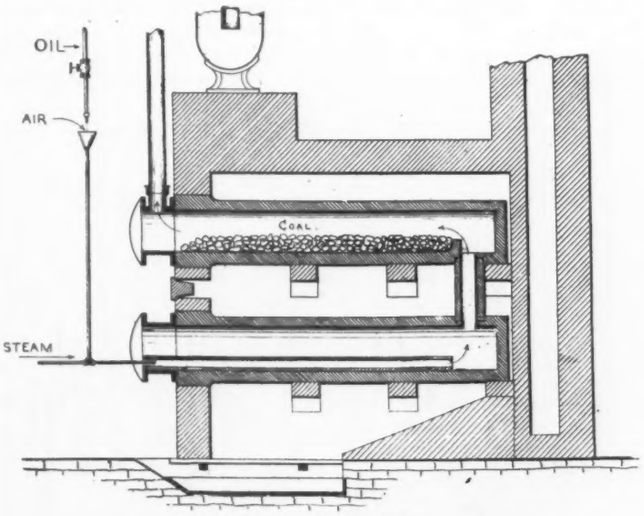


Fig. 8. Slade Apparatus.

the water gas passed from the rear of the lower retort up to the rear of the coal gas retort above and through it to the ascension pipe and hydraulic main. The chief claims for this method were the low cost of equipment, high candle power of gas, and "general economy". It was, we believe, the last of the externally fired retort processes for making water gas.

Generator-Retort Systems.—The "Acme" was one of the lesser generator-retort systems, and was used at Saratoga, N. Y., and in the works of the Mutual Company, Chicago. As operated at the latter place, the blue gas was passed through round iron retorts in the firing benches, one of the features being the firing of these benches by oil, using the products of combustion to heat the blue gas and oil before admission to the retorts. The use of wrought iron retorts was a weak feature of this system.

Another apparatus of the generator-retort type, erected so far as is known only in New London, Conn., was the Harkness. Natural draft was used in the generator, which was small, and

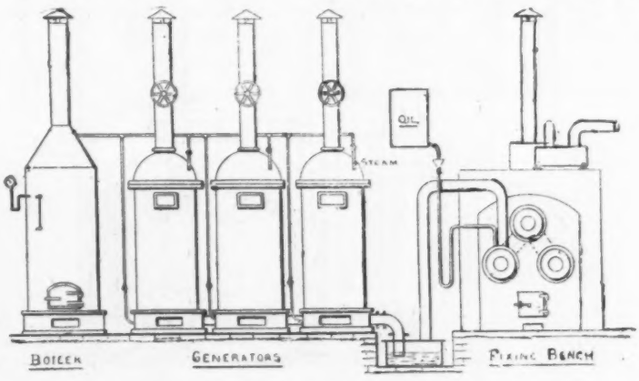


Fig. 9. Harkness Apparatus.

difficult to maintain in proper condition and to fire. The gas went as made, regularly or irregularly, directly to the retorts, where it was carburetted and the oil vapors fixed. To correct the small capacity of the blue gas part of the plant, other generators were added. This system was patented in 1874.

In 1878 the United Petroleum and Water Gas Company brought out the system known as the Hanlon-Johnson, which attained some success, being established in Rochester, N. Y., Reading, Pa., Dover, N. H., San Francisco, Cal., Atlantic City, N. J., and other places. As may be seen by the cut pure oil gas, made in a "Hanlon" bench, and blue water gas were stored in separate holders, the outlets of which were connected and led to an exhauster. By adjusting the respective valves any desired candle could be rigidly maintained, and in that respect the apparatus was superior. It had, however, the weaknesses of all generator-retort systems.

Another apparatus making water gas and oil gas separately was that invented by H. H. Edgerton, installed in Danbury and Wallingford, Conn., Pensacola, Fla., New Orleans, La., and other places. In this system an economy was effected in utilizing the blast gases to heat the retorts, each bench containing two generators, operating alternately, so that a continuous heat would be obtained. The water and oil gases, after being separately made and metered, were drawn by exhausters, mixed cold, and passed through the purifiers to the storage holder. One feature of the Edgerton process was the distribution of a gas of very high candle-

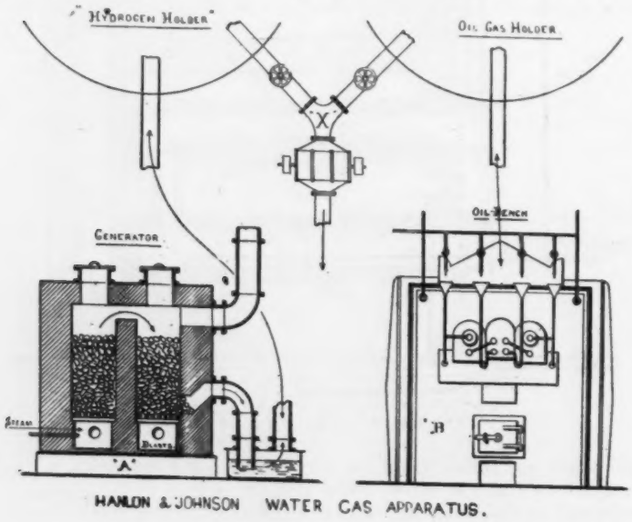


Fig. 10. Hanlon & Johnson Apparatus.

power sold on the basis of the amount of light delivered, and measured through meters, registering in dollars and cents instead of cubic feet.

The Meeze system was patented in England and, under the International Gas Company, plants were erected in New York, New Orleans, and elsewhere. The apparatus consisted of fireclay retorts in an ordinary setting. In the center of each retort was an "ingression pipe", leading almost to the rear end, and filled with "bafflers", through which a jet of superheated steam and hydrocarbon vapors was passed. After leaving the "bafflers", and expanding in the body of the retort, the vapors passed forward through a second series of "bafflers" to the stand pipes. The rich oil gas was afterwards reduced by mixing with blue water gas admitted to the retort, hydraulic main, or other point.

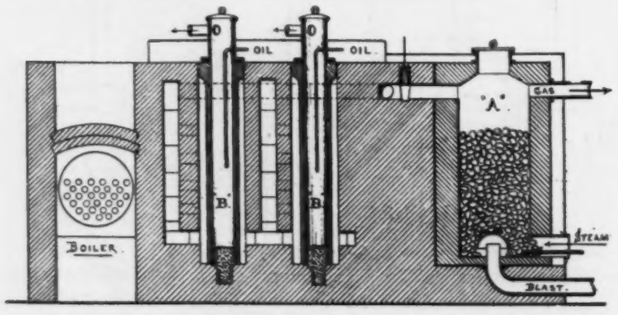


Fig. 11. Edgerton Apparatus.

An inventor, whose ideas had in one respect at least, the merit of novelty, was the Jerzmanowski. He introduced two forms of apparatus: One, the "baby" or "bootleg" system; the other called simply after himself. In the former, L-shaped retorts were filled with limestone and steam, mixed with oil, was injected at the "toe". In passing up through the heated limestone, the vapors were fixed. The inventor credited the lime with peculiar properties tending to decrease purification, but does not satisfactorily explain just what the action was on the gas. Plants of this form have been erected at Albany, Utica, Brooklyn and New York, New York, Boston, Mass., and other points. The other form of Jerzmanowski apparatus will be referred to under the modifications of the Lowe type, which it more closely resembles.

Inventors have tried to overcome the complications inherent in the intermittent operation of generators, and Messrs. F. Egner and McKenzie have attempted to satisfactorily make a producer gas by continuous air and steam admission to be later carburetted in separate retorts. By the former system, the air was drawn

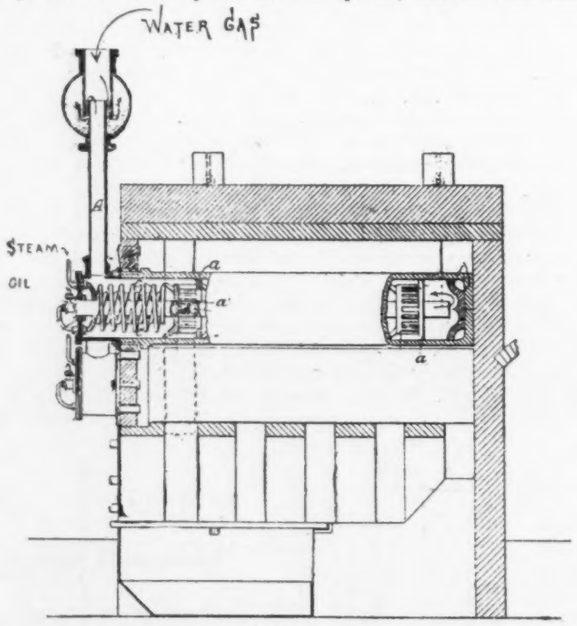


Fig. 12. Meeze Apparatus.

through the producer by a steam jet exhauster, an oil seal at the outlet of the producer being provided to supply the hydrocarbon vapors. This system was tried in St. Louis. In the McKenzie

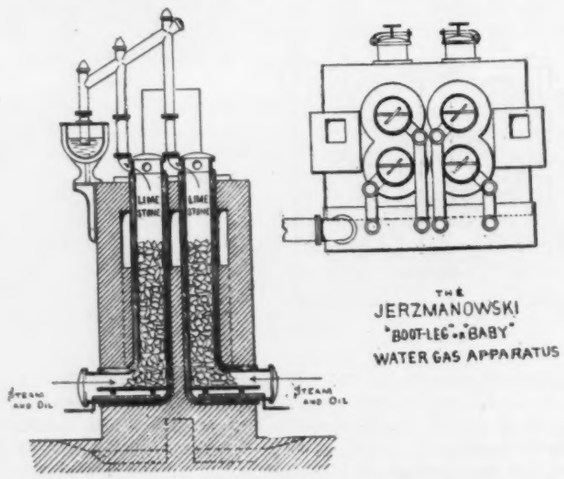


Fig. 13. Jerzmanowski "Bootleg" or "Baby" Apparatus.

apparatus, forced blast was used. This method preceded the Tessie du Motay, at the Knickerbocker works, New York City, and later was introduced into other smaller plants, among which was the

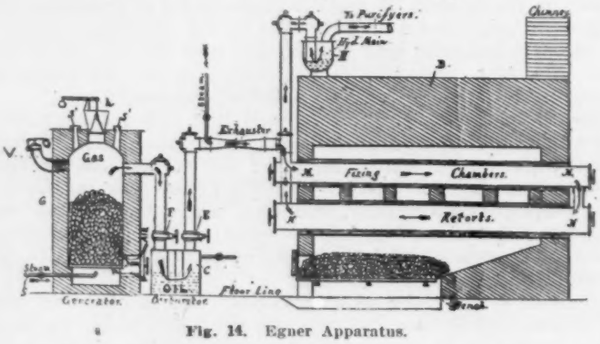


Fig. 14. Egner Apparatus.

New York and East River Gas Company of Long Island City, N. Y.

Another process which might be classed among the generator-

retort systems was the Askins, erected at Lima, Ohio, originally, then at Bellefontaine, Ohio, and at one or two other points in the Middle West. This apparatus consisted of two ordinary generators, connected at the top, as shown in the cut. One generator had a small amount of checkerbrick in the top, while inserted in

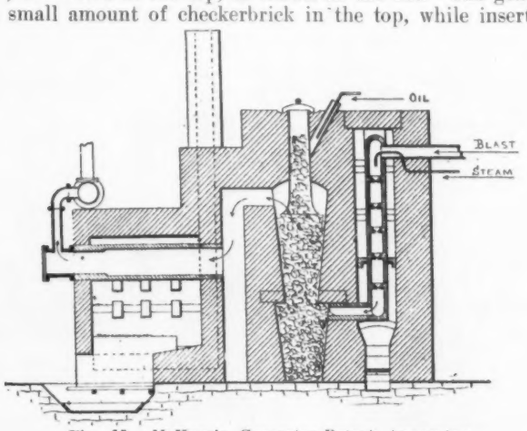


Fig. 15. McKenzie Generator-Retort Apparatus.

the other were a couple of small superheating retorts. The operation was intermittent, natural draft being used. During a run steam entered below one grate, and oil was admitted to the checkerbrick above; the gases mixed and passed through the "superheating retorts". The obvious defects of the system are the lack of proper provision for fixing the gas and the small capacity due to the use of natural draft.

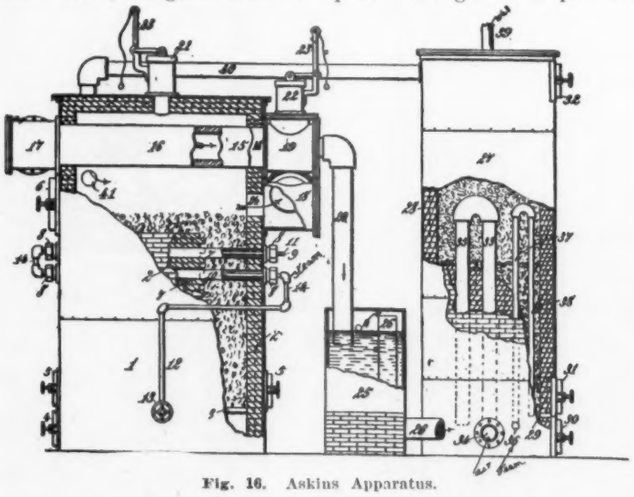


Fig. 16. Askins Apparatus.

The only generator-retort systems aside from the Edgerton,

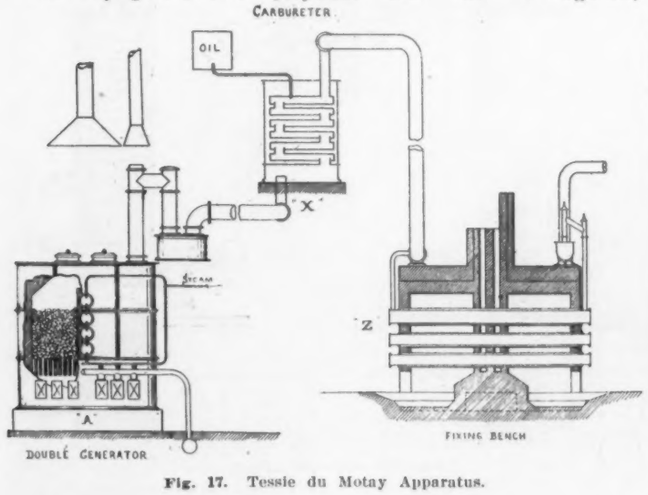


Fig. 17. Tessie du Motay Apparatus.

which had sufficient merit to be adopted to any considerable extent, and to have been used beyond what might be termed the experimental stage, were the Tessie du Motay and the Wilkinson. These two processes closely resembled each other, the main difference being in the fact that, in the Wilkinson, provision was made for up-and-down runs, this being the first apparatus to possess this valuable feature. In both systems, blue water gas, or "hydrogen gas", as it was called, was made and stored in a "hydrogen" holder,

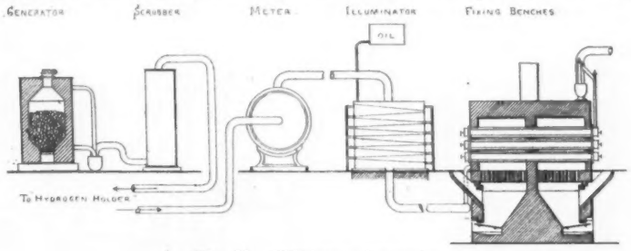


Fig. 18. Wilkinson Apparatus.

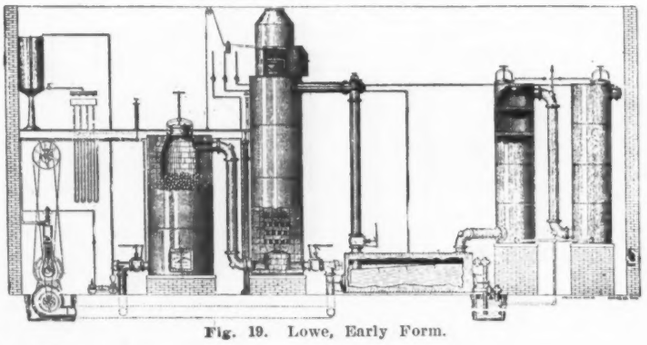


Fig. 19. Lowe, Early Form.

Fig. 20. Lowe, 1890, Apparatus.

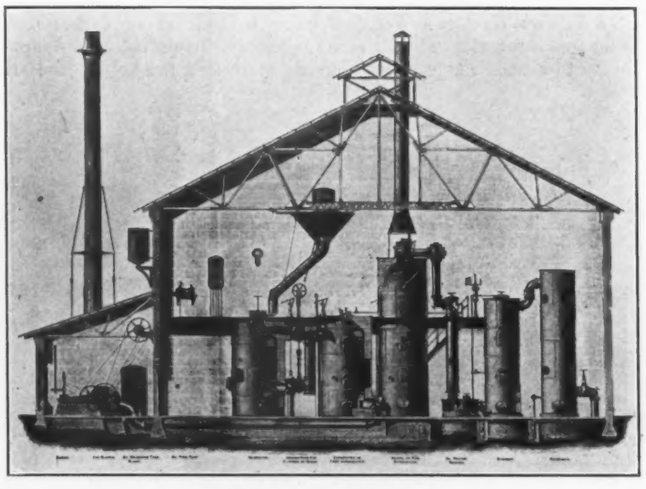


Fig. 21. Lowe, Modern Form.

from which it was exhausted and put through a steam-heated evaporator, or "illuminator", where it picked up naphtha vapors. The water gas and oil vapors then passed through retorts, where the

gas was fixed. The Tessie du Motay system was introduced into a number of plants in New York and Brooklyn, and into Yonkers, N. Y., Jacksonville, Fla., etc. The first Wilkinson plant was erected at the New York Mutual Gas Company's works, Baltimore, Md., Washington, D. C., Hoboken and Newark, N. J., Buffalo and Rye N. Y., Haverhill, Mass., etc.

These two systems did good work, making a uniform grade of

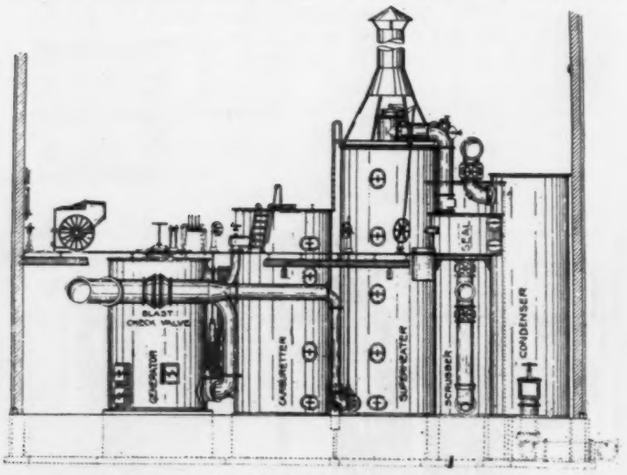


Fig. 22. Western Gas Construction Co.'s Apparatus.

high candle power and well-fixed gas. The objections to the systems are that they were virtually tied down to the use of naphtha for carburetting, wasted the blast gases, and required the mainten-

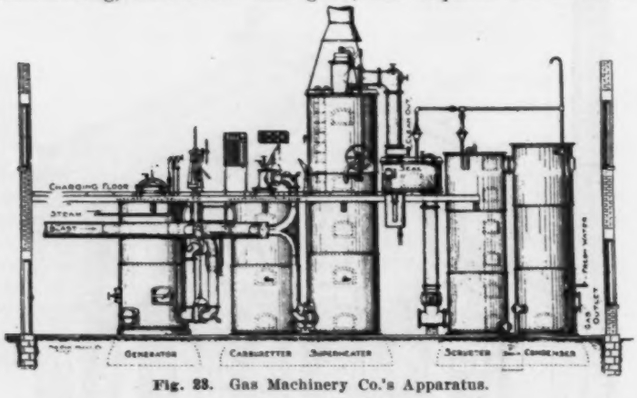


Fig. 23. Gas Machinery Co.'s Apparatus.

ance of a secondary fire for fixing the gas. These points have caused the systems to be superseded by the more economical Lowe type in every place, as far as we have any record, except Haverhill, Mass.

The Lowe System.—We now come to a form of carburetted water gas apparatus which, by its economy, flexibility, and adaptability to a wide range of gas making materials, has superseded all

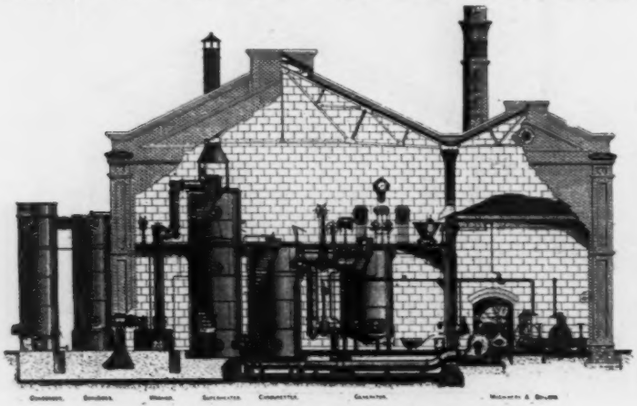


Fig. 24. Humphreys & Glasgow Apparatus.

others, and upon which all modern forms of carburetted water gas systems are based. This is the one invented by Prof. T. S. C. Lowe, Norristown, Penn. Prof. Lowe, as Chief Aeronaut of the Army of the Potomac, became engaged in the manufacture of gas for balloons during the Civil War, and, in 1872 and 1875, took out patents covering the separate fixing chamber heated by internal

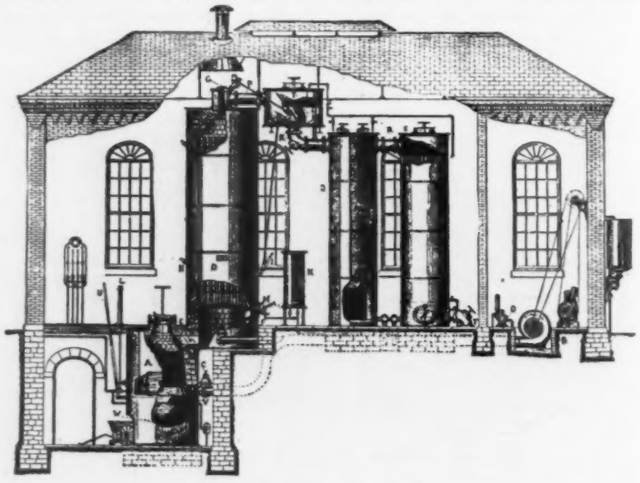


Fig. 25. Granger-Collins Apparatus.

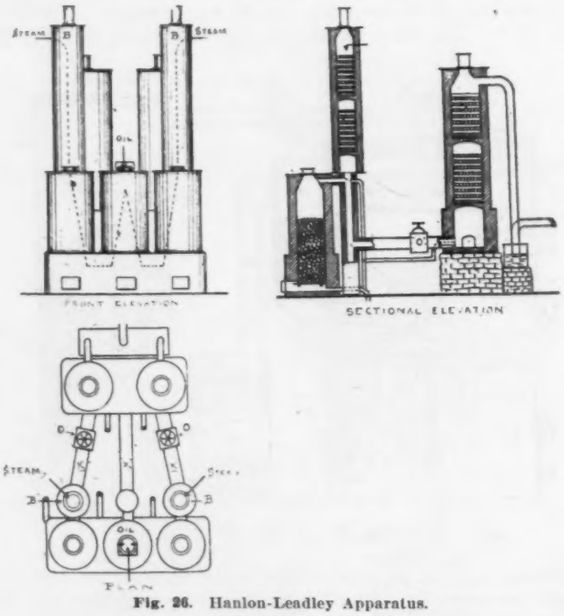


Fig. 26. Hanlon-Leadley Apparatus.

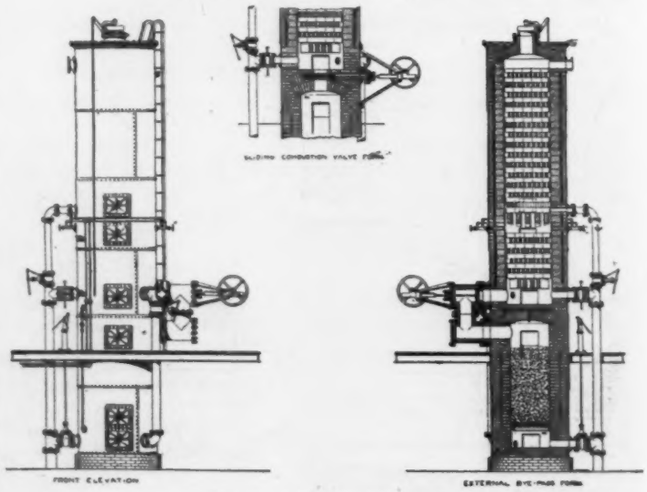


Fig. 27. Springer Apparatus.

In 1874 he erected a plant at Phœnixville, Pa., and later one at Conshohocken, Pa., and another at Columbia, Pa. combustion of the blast gases from the generator, the basis of all forms of Lowe water gas apparatus.

Several firms now undertook the erection of the Lowe apparatus, among them being S. A. Stevens & Co., who later organized the American Gas Fuel and Light Co.; A. O. Granger & Co., builders of the Granger-Collins apparatus; Pierson Bros., and the National Gas Company, holders of the Springer patents. In 1882, the owners of the Lowe patents and the National Petroleum and Water Gas Company controlling the Hanlon-Johnson patents, combined to form the United Gas Improvement Company. This company

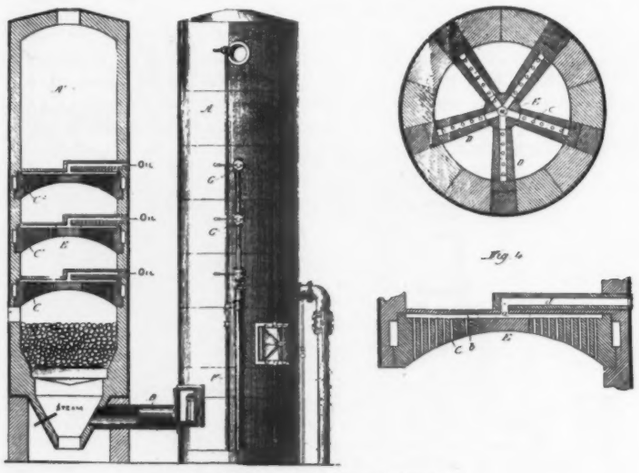


Fig. 4.

Fig. 28. Pratt & Ryan Apparatus.

inaugurated the plan of buying and leasing gas works, installing the Lowe system, and operating the plants for the profits in the sale of gas.

The first improvement made in the old form of Lowe apparatus was in enlarging the gooseneck between the generator and superheater to make another superheater of it—the "first superheater" as it was then called in contradistinction to the "second superheater". The "second superheater" was then made higher for the purpose of obtaining greater fixing surface, producing the 1890

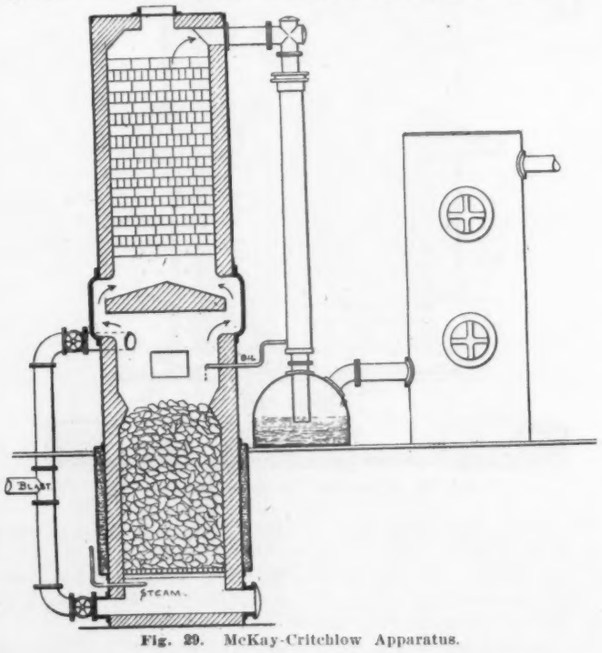


Fig. 29. McKay-Critchlow Apparatus.

style of apparatus. The next important change was the introduction in 1891 of the arrangement for making up-and-down runs, which has since become universal, and producing the apparatus virtually in its present form. The alterations in design since that time have not been radical; they have, however, been such as to add to efficiency, capacity, convenience and safety in operating; and it is to be noted that, with the exception of the apparatus of the Economical Gas Apparatus Construction Company and that of Sutherland, noted elsewhere, all the modern forms of apparatus are of the standard, double-superheater type, the designs only varying in mechanical detail, as may be seen by reference to the cuts of the apparatus built by the United Gas Improvement Company, the Western Gas Construction Company, and Gas Machinery Company of America, and Humphreys and Glasgow, of London, England.

A modification of the double superheater system was the Humphreys, erected in Chicago and Toledo in 1889. This consisted

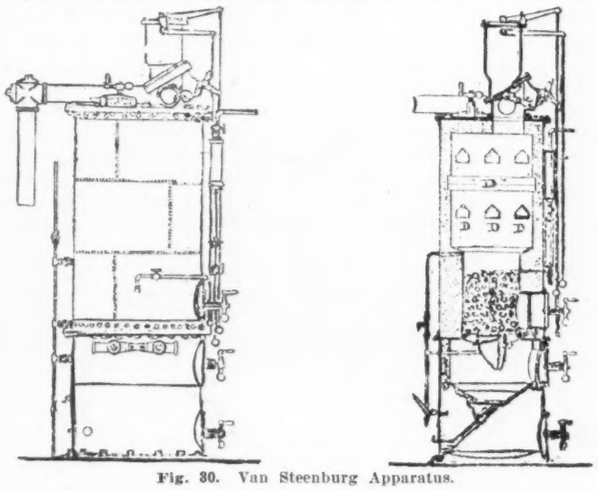


Fig. 30. Van Steenburg Apparatus.

of two complete sets of apparatus with the generators connected at the top. These were blown in parallel; steam was then admitted at the top of one superheater, passing through it to the generator, becoming highly superheated on its way. It then passed up through one generator and down through the other, the idea being to effect thorough decomposition. It was then carburetted in the usual way.

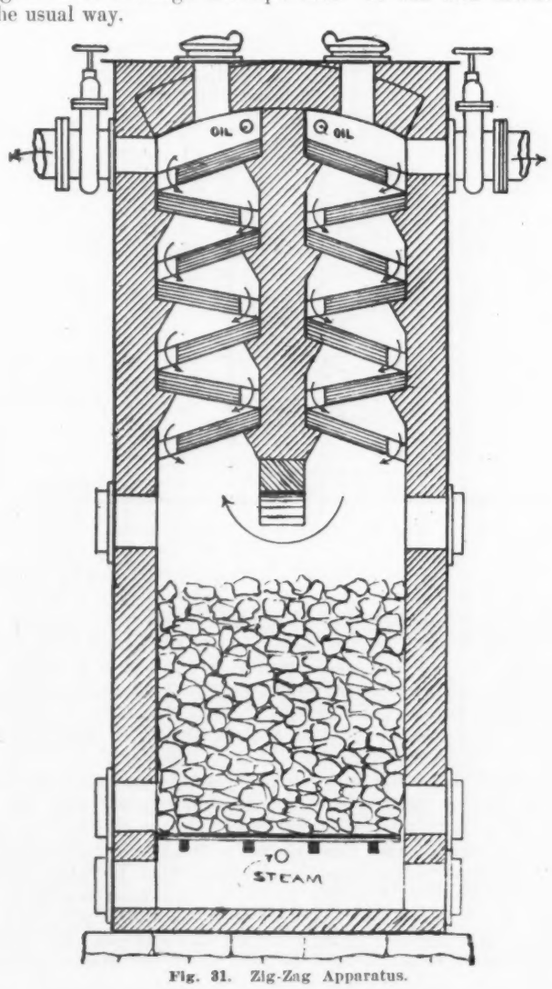


Fig. 31. Zig-Zag Apparatus.

One of the most progressive of the firms constructing water gas apparatus was the A. O. Granger Company, whose later form of apparatus is shown in the cut. In this, the single-shell type was modified by shifting the superheater portion to give direct

access to the generator fire, thereby removing the chief objection to the single-shell machine. This Company followed the practice of the United Gas Improvement Company in buying and operating works in addition to acting as constructing engineers. The machine was very successful, being of low first cost, extremely convenient to operate and, for those times, very economical in results obtained. This Company operated until suit was brought for infringement of patents, when the matter was settled by joining forces with the United Gas Improvement Company. Up to this time the Company had erected over 70 sets of apparatus in various parts of the United States.

Suit was also brought against the New Haven (Conn.) Gas Company, this being made a test case upon which the validity and scope of the Lowe patents were to be decided. After long litigation, a decision was rendered in favor of the purchasers of the Lowe patents, thus establishing once-for-all the status of the internally fired fixing chamber.

The Hanlon-Leadley apparatus just referred to was distinguished by two or three generators on a common communicating base. These were all "blown" together, part of the products being used to heat the small superheaters shown in the cut, while the

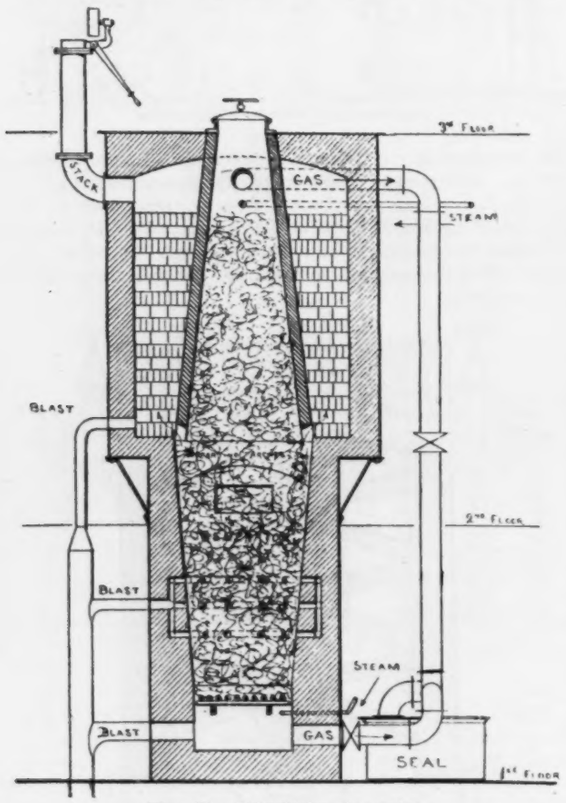


Fig. 32. Fahnehjelm Apparatus.

rest of the gases passed to the two large superheaters on a common base. Steam was admitted to the top of the small superheaters, becoming superheated in its passage down. The two streams then passed down through the two outside generators, and then passed together up through the center generator, at the top of which the oil was admitted. The gases then passed to the superheaters and out. Plants were erected at Passaic, N. J., and then at Reading, Pa., New Haven, Conn., Chicago, Manchester, N. H., Philadelphia, Pa., etc.

There were a number of general forms of apparatus which at one time were popular, but which have practically gone out of use. One of these was the "double-decked," or single-shell, type with the generator and superheater vertically over each other. The Springer, controlled by the National Gas Light and Fuel Company, erected, in Chicago in 1882, then in San Francisco, Cal., St. Paul and Minneapolis, Minn., and other places, is an example of this design. In this the oil was sprayed into the top of the generator by steam; and in some forms the direction of the gas through the generator and superheater could be reversed.

Another form of apparatus in this class was the Pratt & Ryan, dating from 1887. As may be seen by the cut, in place of the checkerbrick was a series of arches, each of which served as an oil inlet, the arches being perforated and cored. Any particular arch could be used at will according to the heat. Several large plants were remodelled on these lines in Chicago, and smaller plants were erected at Goshen, Ind., Creston, Iowa, etc.

The McKay-Critchlow apparatus, another plant of this type, built under the patents of Peter English, contained, instead of the usual perforated arch between the generator and superheater, a solid arch around the edges of which the gases from the generator had to pass. This was the sole distinguishing feature, and greatly improved results were claimed for it, although upon just what grounds is not known. This apparatus was also used for carburetting natural gas, and was the most successful one developed for this purpose. The natural gas was, in part, substituted for the steam and passed up through the fire, after which it was carburetted in the usual way. The first plant was erected at London, Ont., in 1882, and was followed by many other plants in small towns in New York, Pennsylvania and Ohio.

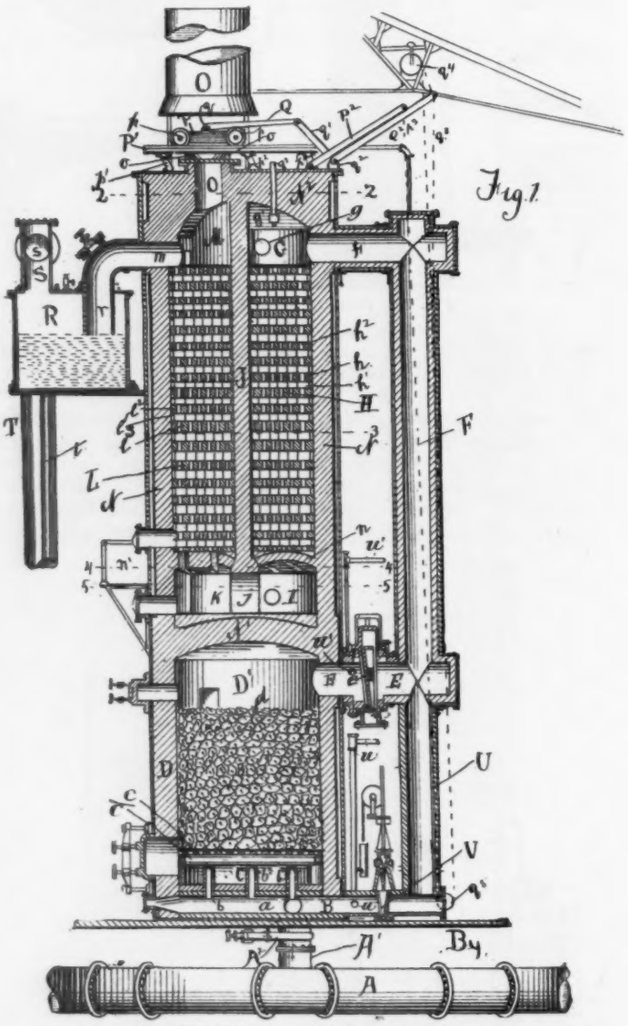


Fig. 33. Williamson (Eustace) Apparatus.

The Fitch apparatus, built by the Union Gas Association of New York, was erected at Garden City and Jamaica, N. Y., in 1892 and 1893. This was almost identical with the early forms of Springer machine, except the gases passed down through the superheater during the run, and up during the blow.

The patents for the B. Van Steenberg apparatus were taken out in 1881, and consisted in inserting firebrick tile, crosswise, in the top of the generator. Owing to the very limited superheating surface, the apparatus was confined to the use of the very lightest grades of oil. Plants were erected at Goshen, Herkimer and Amsterdam, N. Y.

Still another of the single-shell type was the "Zig-zag" apparatus, built at McKeesport, Pa., by the W. J. McClurg Gas Construction Company. The superheater part of the machine was divided by a vertical partition wall, the two chambers thus formed containing inclined baffle plates. In running the oil was admitted alternately at the top of each chamber, passing down through it and up through the other.

The Fahnehjelm apparatus, designed for the use of soft coal, might also be considered in this class. This resembled the usual type of such apparatus, except for an extension of the generator extended centrally through the superheating chamber to the top of the apparatus, forming a retort for the distillation of the coal.

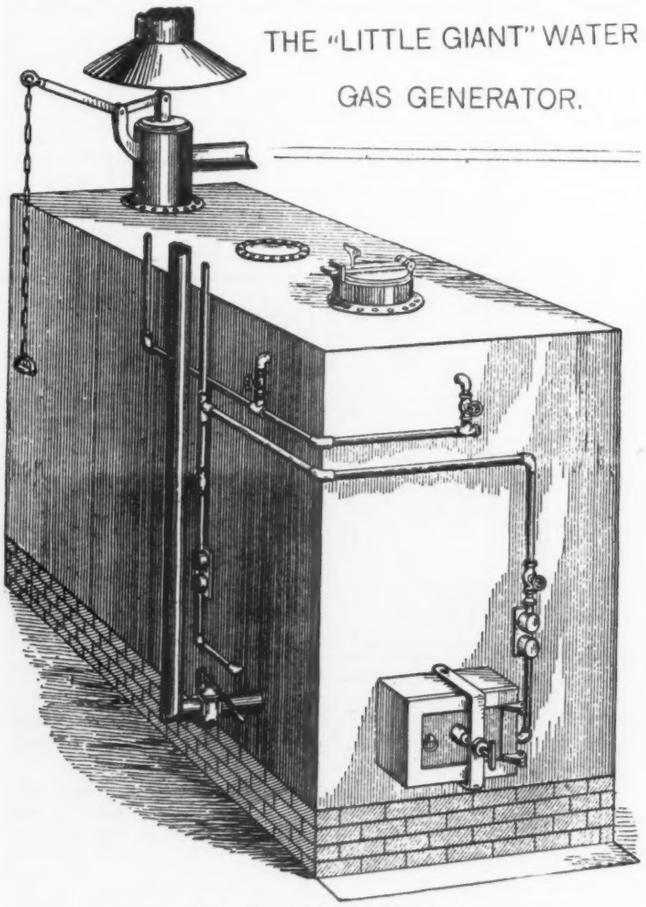


Fig. 34. Sutherland Apparatus.

This was tried for some time by the Mutual Fuel Gas Company, of Chicago, and St. Joseph, Mo. In Jackson, Mich., a similar arrangement was tried, but with six smaller retorts to subdivide the mass to be coked. Here a non-luminous gas was distributed and Fahnehjelm burners were used throughout the town.

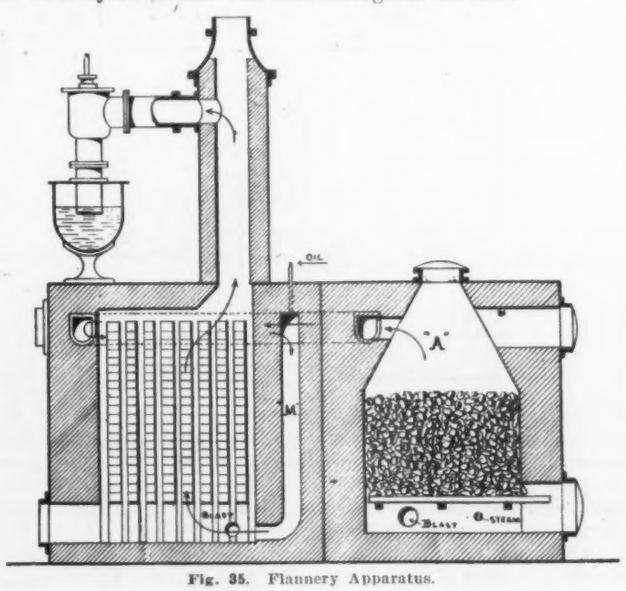


Fig. 35. Flannery Apparatus.

For one reason or another, the erection of all the above forms of single-shell apparatus has been discontinued. The only one that is now built is that known as the John Williamson, patented by J. H. Eustace. This was first put into operation at the works of the Peoples Gas Light and Coke Company, Chicago, and was

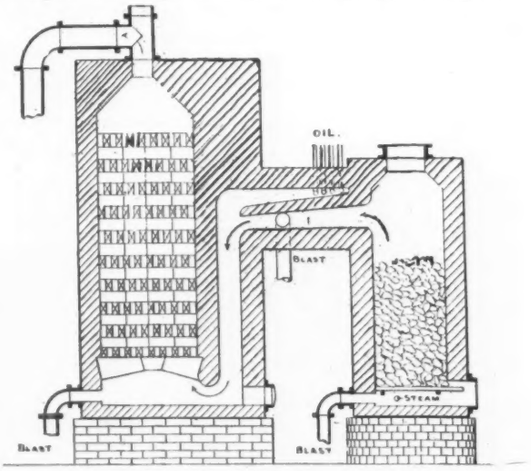


Fig. 36. Martin Apparatus.

built with a view to utilizing the old Springer shells and to avoid altering the buildings. The cut, while taken from a patent drawing, is a good representation of the apparatus as there constructed. The principal changes were in putting a solid partition between

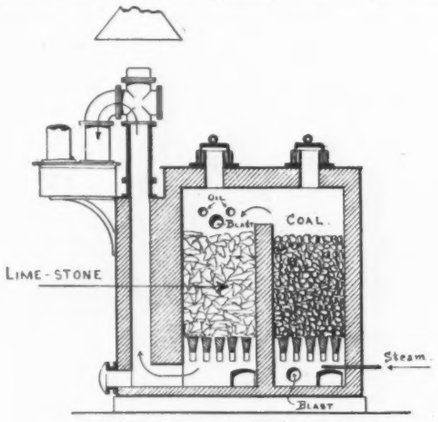


Fig. 37. Jerzmanowski Apparatus.

the generator and superheater, in dividing the superheater into two chambers by a vertical wall, and in bringing the gases by an outside connection from the generator to the top of the superheater. Here they meet the oil and pass down in that chamber and up through the other. Plants have been erected at Brooklyn,

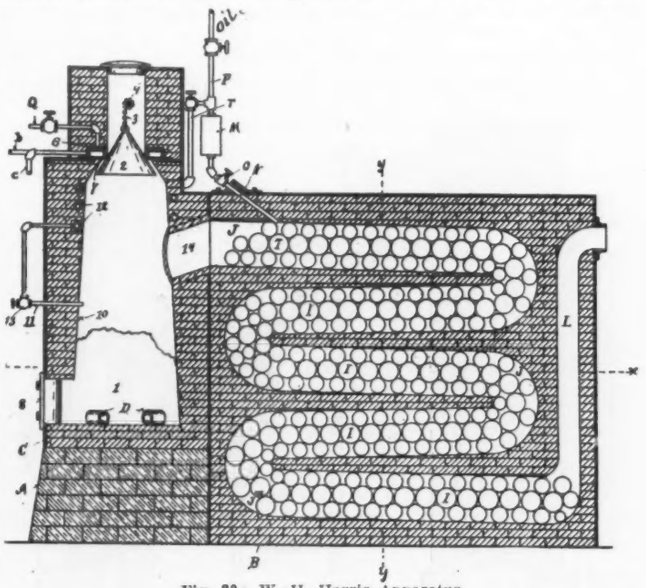


Fig. 38. W. H. Harris Apparatus.

Albany and Utica, N. Y., and Memphis, Tenn. In order to avoid the sharp corners, between the curved sides of the lining and the straight partition, the later forms of apparatus are built in an oval shell with circular superheating chambers.

The next type of Lowe apparatus to be considered is that in which the generator and superheater are placed alongside of each

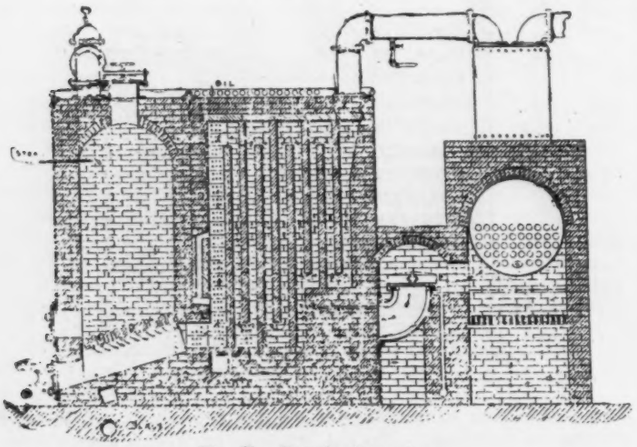


Fig. 39. Loomis Apparatus.

other in a single shell. The Sutherland is the only survivor of this type, its chief claim to recognition being its low first cost. It is in use in several small towns in New England.

The Flannery and Martin were other examples of this type, the principal difference between them being the manner of introducing the oil. In the former, it was admitted to a D-shaped

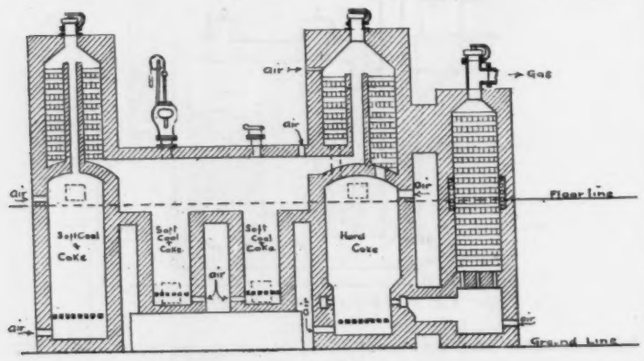


Fig. 40. Rose-Hastings Apparatus.

retort, built in the lining and encircling the superheater, while in the latter, it was dropped upon a slab between the generator and superheater. The Flannery apparatus was installed in the works of the Bay State Gas Company, Boston, Standard Gas Company,

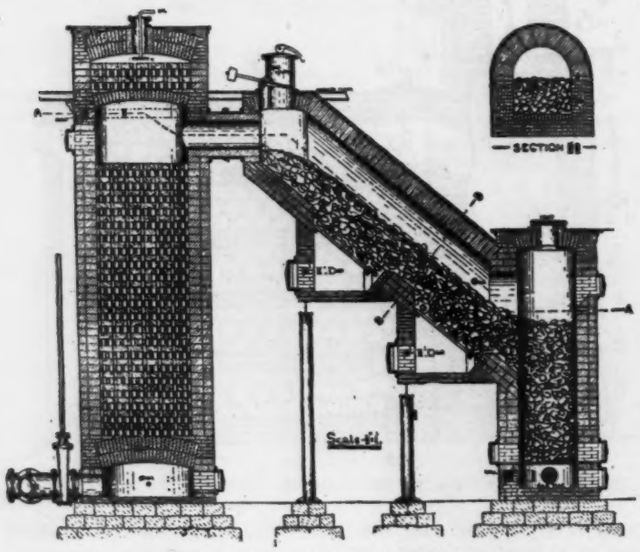


Fig. 41. Rew Soft Coal Apparatus.

of New York, and the Consumers Gas Company, Jersey, City, N. J. Plants on the Martin system were erected at St. Paul, Minn., Newburgh, N. Y., Washington, D. C., Macon, Ga., etc.

Another plant on this order was the Jerzmanowski. In this the distinguishing character was that the superheater was filled with limestone or hard burned lime. The gas made by this process was of low illuminating value, and was further enriched to any desired extent by carburetters and retorts as in the "bootleg" system.

One peculiar plant of this type was that designed by W. H. Harris, and exploited chiefly in Kentucky, Ohio and Indiana, in

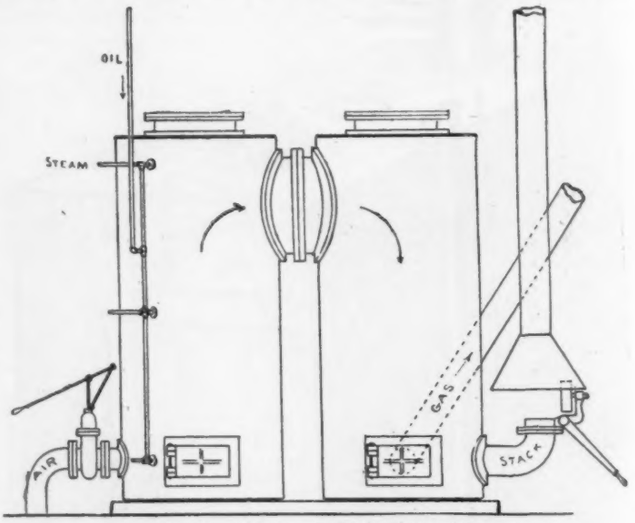


Fig. 42. Janeway & Banks Apparatus.

1891 and 1892. In this, the fixing chamber consisted of a sinuous passage filled with fire-brick balls, aptly described as a "snake with firebrick balls in its belly".

While the Loomis system has been generally pushed as a fuel gas, plants were erected in Cottage City, Mass., to furnish illuminating gas, and another in Sandusky, Ohio. This was designed

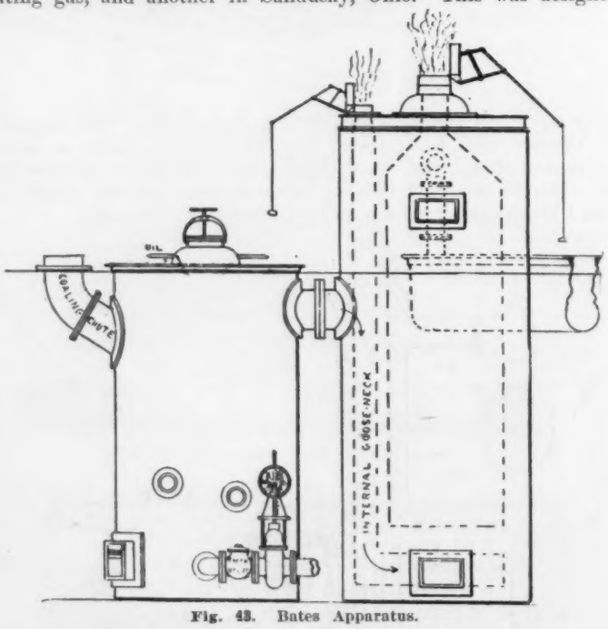


Fig. 43. Bates Apparatus.

for the use of soft coal; and, to prevent deposit of ashes or soot, the superheater was built with thin, vertical, partition walls instead of being filled with checkerbrick. The generator was built for down-runs and blows. In other respects the apparatus closely resembles others of the Flannerry and Martin type.

One apparatus, constituting a type all to itself, was the Rose-Hastings, erected at Westchester, Pa., and Elkhart, Ind., and also intended to use soft coal. In that machine there were four fuel beds, all connected together, and of various diameters. In the first, clear oven coke was used, and in the others, mixtures of coke and soft coal. In operating, all the fires were blown together.

During the run, steam was turned through the mixed fuel beds and then met the injected oil. Thence the gases passed through the superheating chambers and through the coke fire for fixing.

Another apparatus built on original lines was the Rew, handled by the National Gas and Water Company, of Chicago, and with plants at Cicero, Ill., and Kansas City, Mo. The main feature here was the inclined retort between the generator and superheater, in which the soft coal was coked. The apparatus was built in pairs, and the method of running was as follows: By simultaneous blasting and exhausting, a neutral pressure was maintained in the apparatus, and the superheater and coking chambers were heated by secondary air. Before beginning to make

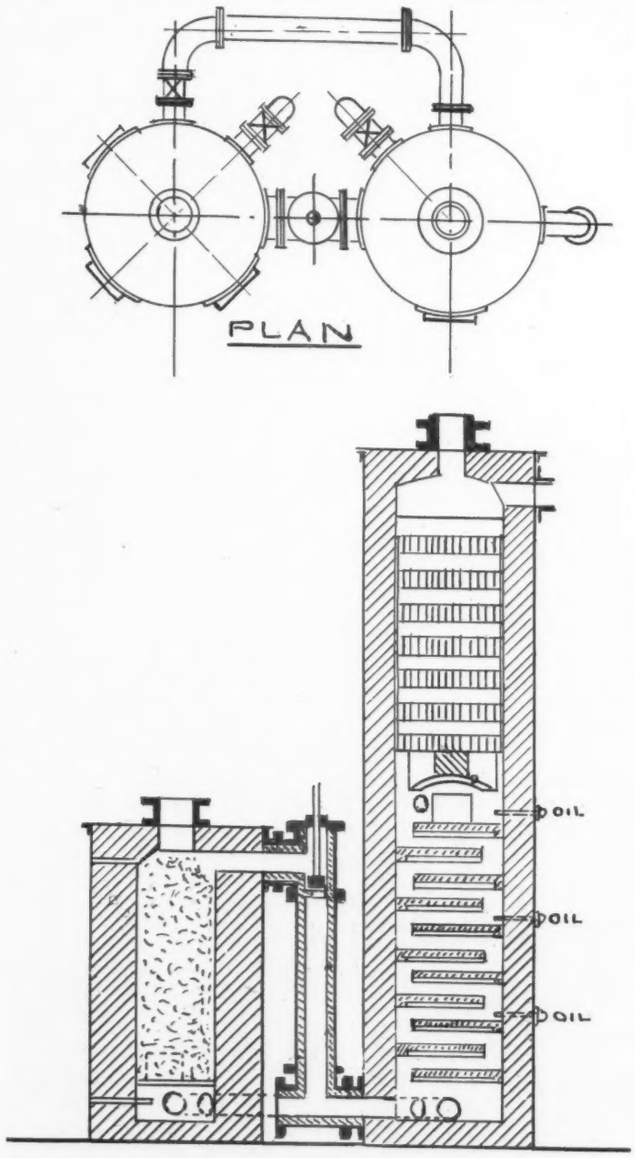


Fig. 44. F. D. Moses Apparatus.

gas, a charge of soft coal was dropped into the retort on one side, then steam was admitted at the base of the superheater on the other side. The steam passed upwards through the superheater and then through the retort and two generators, one after the other. The resultant gases passed over the charge of soft coal, met the oil at the top of the superheater, through which they passed downwards, becoming fixed on their way. When the consumption was small, or when it was desired to make repairs, one machine of the pair could be shut down, and gas made on the other.

But one type of Lowe apparatus now remains to be described, and that is a reversion to the original two-shell form. With one exception, these designs have also all fallen into disuse.

One machine of this class was the Janeway and Banks. In this combustion took place in the generator only, the superheater being heated by the sensible heat of the blast gases. The chief claim was the admission of a surplus of steam, which was supposed to envelop and protect the oil particles, thereby preventing the formation of

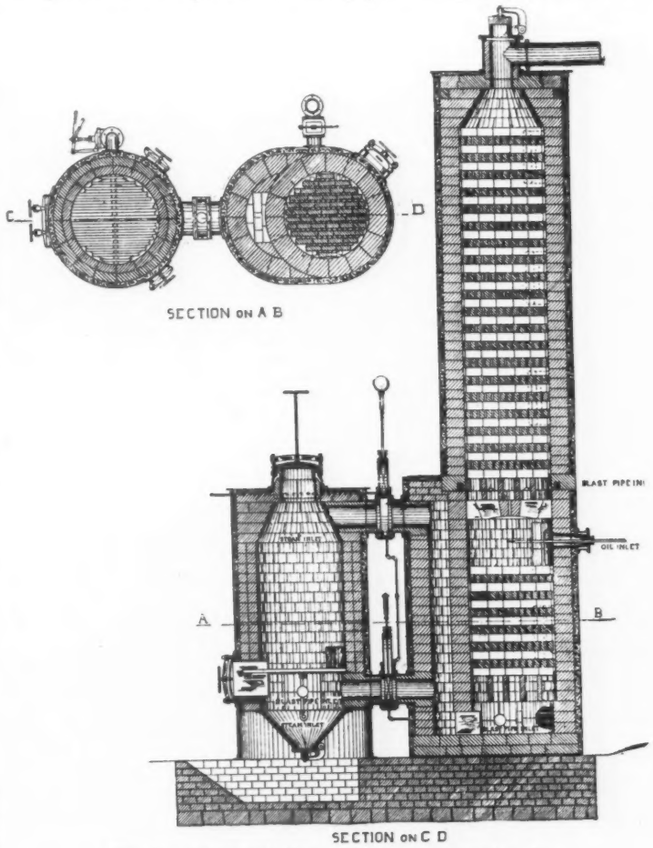


Fig. 45. Economical Gas Apparatus Construction Co.

lampblack. A plant of this form was erected at Royersford, Penn.

The Bates, put in at Camden, N. J., was another apparatus of the two-shell type. Its only distinguishing feature was in placing the gooseneck flue in the superheater lining instead of carrying it down between the shells.

The chief characteristic of the F. D. Moses design, erected at Seymour, Ind., in 1892, was the tall superheater, the lower part of which contained firebrick slabs upon which the oil was sprayed, while the upper part was filled with checkerbrick in the usual manner. The side connection for making down runs may be seen in the cut.

The only apparatus of this type that has been extensively adopted, and that is in present use, is that of the Economical Gas

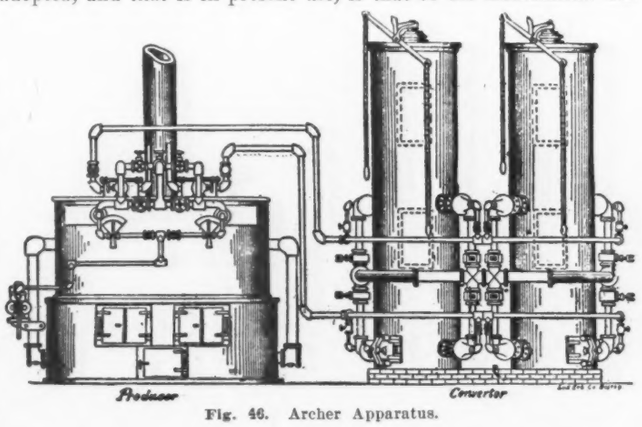


Fig. 46. Archer Apparatus.

Apparatus Construction Company, of Toronto, Canada, and London, England. With this apparatus, up-and-down runs may be made in generator or superheater, or both as desired. The principal success of this apparatus has been in England, where a number of plants are in successful operation. The claims made by the

inventors of this apparatus are improved fuel and oil results, catching of dust before it reaches the checkerbrick, and saving in ground space.

Oil-Water Gas.—A form of water gas apparatus that is becoming very popular, where oil is cheap and coal dear, is that known as

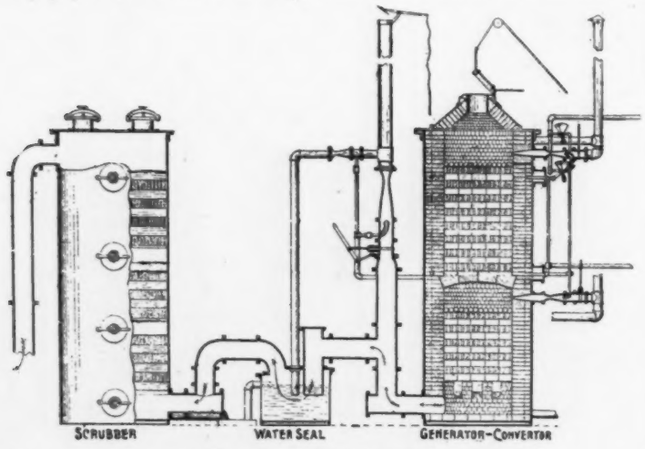


Fig. 47. Kendall Apparatus.

"oil-water gas". The idea is not new, as the Archer, Kendall, McKenzie, Parker and Van Syckel processes of the early 90's were designed for the use of oil instead of solid fuel. All of these systems comprise the internally-fired, superheater characteristic of the T. S. C. Lowe patents.

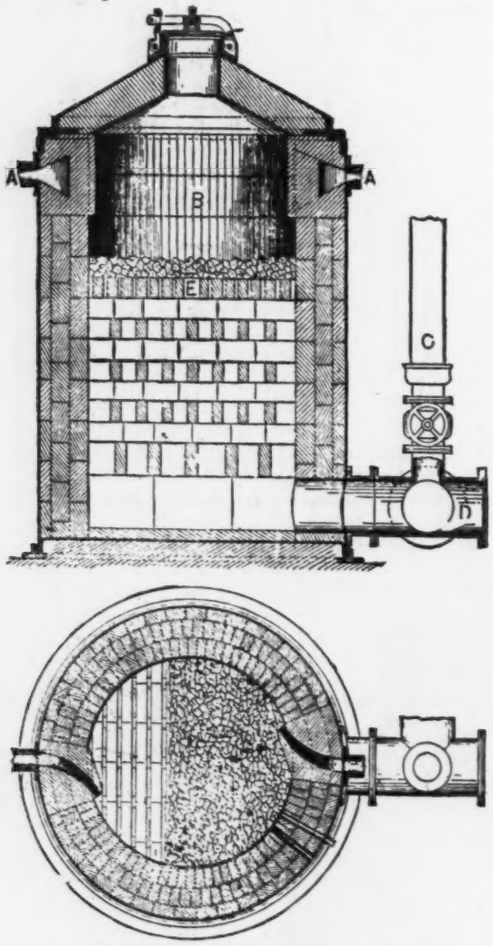


Fig. 48. McKenzie's Later Apparatus.

The first, handled by J. B. Archer, of Washington, D. C., comprised a number of small drums and coils into which oil and steam were sprayed, and which were set in a furnace fired either with coal or oil. The apparatus in this form was installed in a number of industrial establishments for making fuel gas. When the gas was to be distributed throughout a town, however, superheaters of the ordinary type were added. In this form, the process was introduced into Huntington, N. Y.; this, as far as we know, being the only place in which it was used for town lighting.

The Kendall, McKenzie and Parker designs all bore a strong family resemblance as may be observed by the accompanying sketches. The McKenzie was marked by a very low shell, and the fact that the sprays of oil were admitted tangentially to give a rotary motion to the gases. In all of these, blows of oil and air (or oil, air and steam) were alternated with runs of oil and steam, the steam being decomposed by contact with the oil, as it is by contact with coal in the regular carburetted water gas system.

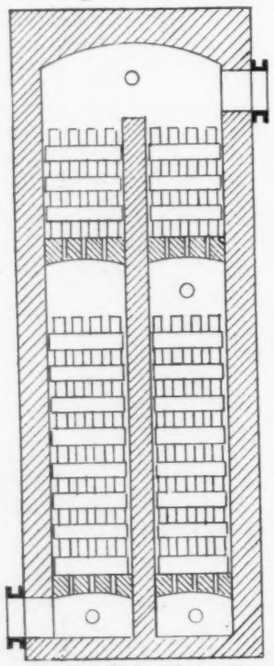


Fig. 49. Parker Apparatus.

The Kendall apparatus was erected at Terre Haute, Ind., the Parker at Liberty and Anderson, Ind., and Belvidere, Ill., and the McKenzie at Garden City, N. Y.

The Van Syckel apparatus also made use of the internally fired chamber, although of a different form. In this the apparatus was rectangular and contained horizontal baffle plates making the gases

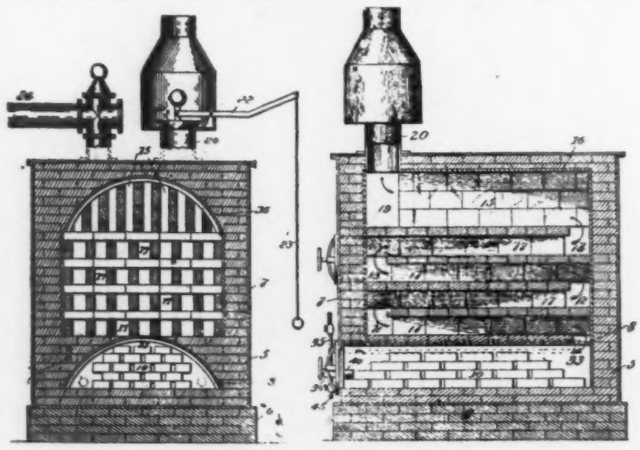


Fig. 50. Van Syckel Apparatus.

travel back-and-forth through the brick work until they reached the stack. Installations of this system were made in small plants in the East and South.

As with other designs, the law of the survival of the fittest applies to oil-water gas processes. All those mentioned have passed away, and the only one left in existence is that invented by L. P. Lowe, and installed in nearly every gas works in California. This apparatus is built in two forms; one in which the generator and superheater are in a single shell, vertically over each other, and the other in which they are in separate shells. The plant is run similarly to the others of the same type. In some plants, a coking chamber is added as shown in the drawing, in which the lamp-

black, made in considerable quantities as a residual in the process, may be coked for steam raising and for market. It is questionable, however, if it is not better to briquette it by the ordinary presses for that purpose, as is done in a number of plants.

Methane-Hydrogen Gas Plants.—A method that has received a good deal of attention in England, and was installed first at Truro, later at Hythe, Bromsgrove, and Swindon, England, and at Versailles and Amiens, France, is the methane-hydrogen process of

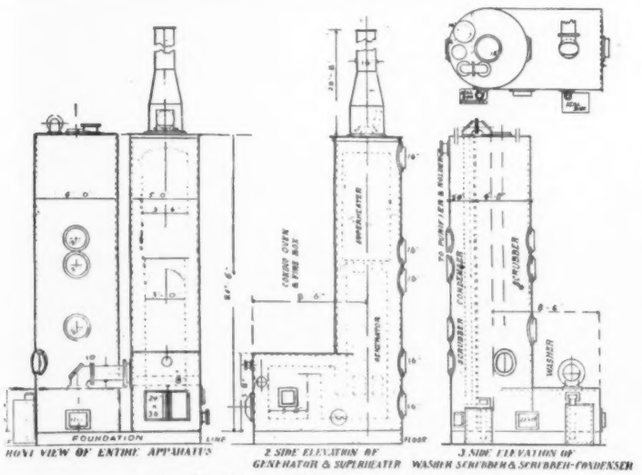

FOUNDATION LINE
FRONT VIEW OF ENTIRE APPARATUS
2 SIDE ELEVATION OF GENERATOR & SUPERHEATER
3 SIDE ELEVATION OF WASHER SCRUBBER & SCRUBBER-CONDENSER

Fig. 51. Lowe Oil Water Gas Apparatus.

C. B. Tully. The process is based on the same principle as introducing tar into the generator of the Lowe apparatus, and is intended to break the tar up into lampblack, methane and hydrogen, the lampblack being filtered out by the coal and consumed

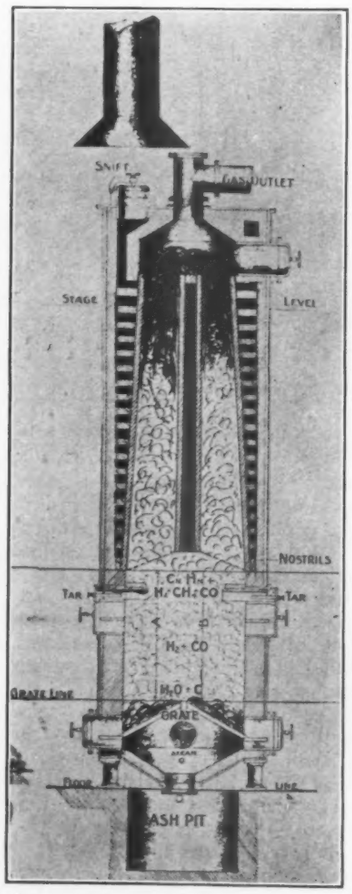


Fig. 52. Methane-Hydrogen Apparatus.

during the blow. The latest design is hypothetically shown in the cut. During the blow, air is admitted under the grate and the products pass through the checkerbrick and out at the snift valve. When the desired heat is attained, steam is admitted below the grate and tar is injected into the incandescent fuel at the pockets shown. The various gases pass up through the fuel, whose temperature decreases towards the top of the apparatus, and then out. The position of the incandescent zone is maintained by the blast take-off nostrils, which divert the blast gases from the upper layers of fuel to the checkerbrick surrounding the column of descending coke.

Blue Water Gas.—There now remain to be described the various

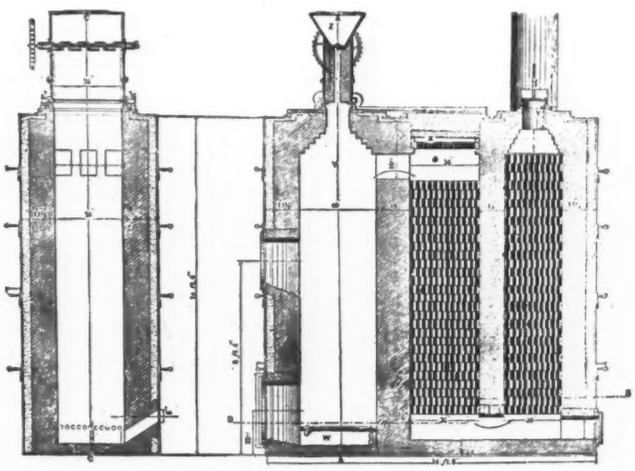


Fig. 53. Strong Fuel Gas Apparatus.

processes for producing blue water gas. The introduction of this gas has been attempted at various places in this country, notably at Troy and Yonkers, N. Y., and Bridgeport, Conn., but without success. In Germany, however, there are a considerable number of small towns in which a straight water gas, carburetted with cold benzol, is distributed, and in both England and Germany, where municipal regulation regarding the candle power of the gas is more lenient, and where consumers have not been educated up to high ideals by the rich water gas sold in this country, blue gas has been mixed with coal gas, either in the retort itself or elsewhere.

In 1880, the Yonkers Fuel Gas Light Company was formed to manufacture, by the Strong process, and distribute a straight, blue gas to be used for fuel purposes, and in 1883, the Citizens' Steam and Gas Light, of Troy, N. Y., was started for the same purpose, using the Lowe fuel gas system.

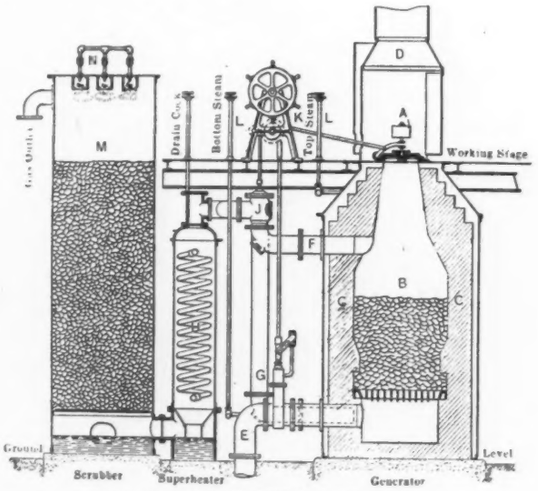


Fig. 54. Dellwik-Fleischer Apparatus.

From 1888 to 1893, about 20 other plants using various processes were launched. Not one of these, however, proved a commercial success. The Troy Company especially got into very serious trouble by broken mains, the escape of gas being accompanied by a number of fatalities.

The first blue water gas system to come into extensive use was the Dellwik-Fleischer, which was first made public about 1896. For this process is claimed as complete a conversion of the oxygen as possible to carbonic acid during the blast, and to carbonic oxide during the run. The method simply requires adjustment

of the depth of fire and velocity of blast to each other. In practice the fuel bed is kept very thin, a short and quick blast is employed, and the steam is admitted very slowly. A large number of plants have been erected in Germany, among them examples at Berlin, Stuttgart, Dresden, Charlottenburg and Breslau, a number in France, including Lyons, Marseilles and St. Quentin; in Tipton, Nottingham, Ilford, etc., in England; and in other places practically throughout the world, except in the Americas, where but one plant has been erected, and that in an industrial establishment. The apparatus itself has no distinguishing features.

The Delwik system was criticised by Dr. Hugo Strache, who

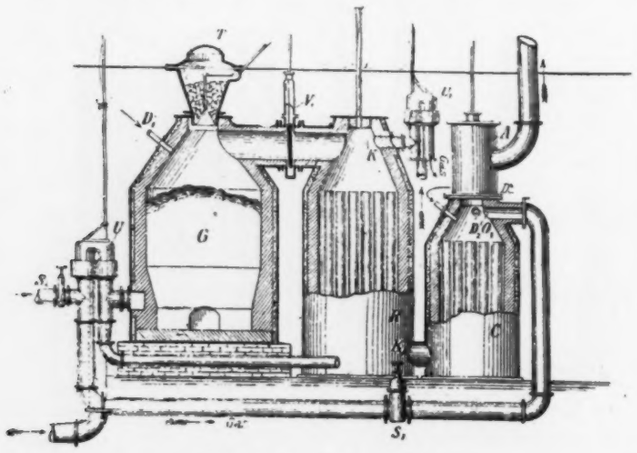


Fig. 55. Strache Apparatus.

argued that the gases left the generator at such a high temperature that the waste through sensible heat was greater than if the temperature were kept lower, and the conversion were not so complete. Strache devised a system according to his own ideas, one form of which is shown in the cut. This machine is operated similarly to the double-superheater Lowe, except that only downruns are made. When used for making carburetted water gas, the gas, leaving the generator, passes by the outside connection to the

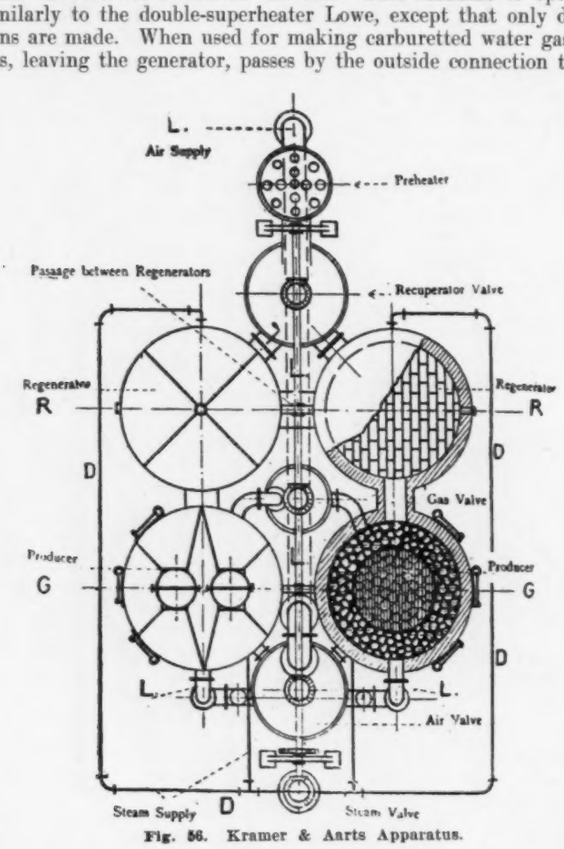


Fig. 56. Kramer & Aarts Apparatus.

top of the further chamber, where it meets the oil; and the combined gases finally leave at the top of the intermediate vessel. When blue gas is made, the steam is admitted at the same point as the oil, and, passing through the two checkerbrick filled vessels, which are preheated by the blast products, becomes superheated in its passage to the generator, through which it passes downwards, and then out. By making the generator higher and providing ports at different heights, the machine has also been designed for soft coal, the upper part serving as a distilling chamber. It has also been modified by omitting the last fixng vessel. A novel arrangement in this apparatus is the valve for directing the flow of gas, which is in the form of an inverted U, sealed in mercury. Plants of this type were erected at Pettau, Styria, Rzeszow, Galicia and Koenigsberg, Germany; and Kharkow, Russia.

One apparatus, embodying novel ideas, is the Kramers' and Aarts, installed, among other places, at Zevenbergen and Amsterdam, Holland; Uxbridge and Leeds, England; and Zurich, Germany. The plant comprises two producers, two checkerwork recuperators, and a tubular recuperator. During the blow the generators are blasted in parallel. During the run, steam is admitted at the bottom of the first producer, where hydrogen, carbonic acid and oxide are formed, and which, with undecomposed steam, pass to recuperators where the rest of the steam is decomposed, liberating hydrogen and oxidizing the carbonic oxide to acid. The gases then pass to the other producer, where the carbonic acid is all reduced to oxide. During the blow, the air is heated by the waste products in the tubular recuperator.

Introduction of Water Gas into Coal Gas Retorts.—This plan has already been referred to under the early history of water gas processes. In 1900, however, Prof. V. B. Lewes revived the scheme in a lecture before the Incorporated Institution of Gas Engineers.

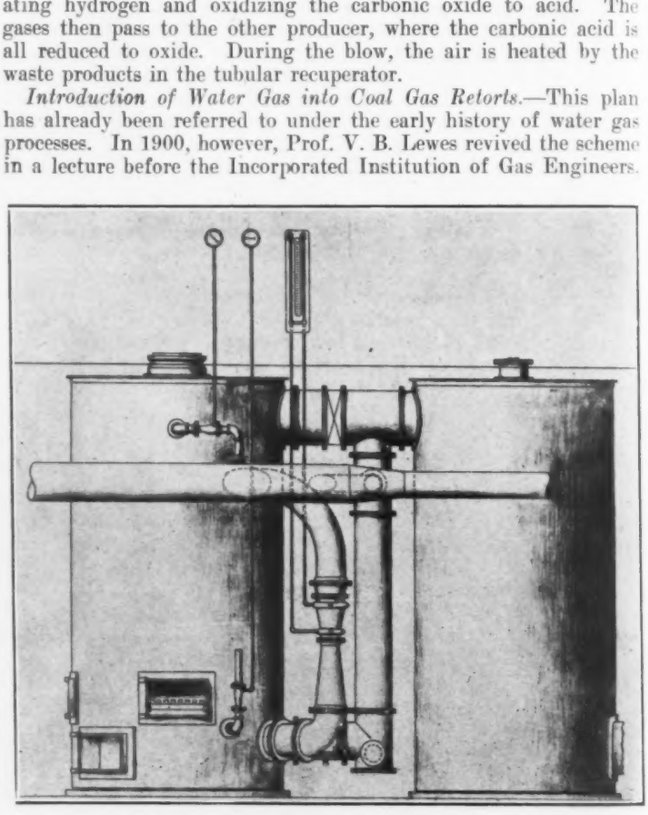


Fig. 57. Air and Steam Measuring Apparatus.

Later he obtained a German patent for the process, which, by-the-way, was afterward nullified. In 1901, experiments were tried and, through 1903, a somewhat acrimonious discussion took place between the advocates of the scheme and others. It was tried in a number of places, some of the experimenters speaking well of it, and others reporting very unfavorably. In some cases, the plan of putting the water gas into the retorts worked unsatisfactorily, and it was introduced at the hydraulic main. The matter is still unsettled, the method being still in use in some places, while in others it has been abandoned.

Operating Water Gas Apparatus.—When water gas first came into use, the methods of handling the apparatus were, according to present ideas, crude in the extreme. Blows-and-runs of an hour were common. By degrees, however, operators came to a realizing sense of the great waste of fuel and oil, and the length of blows-and-runs by degrees decreased until four or five minutes, and in some cases even less, became standard.

Another radical change came into vogue 10 or 12 years ago. It was formerly the idea that the oil should be admitted to the fixing chamber at a low temperature, and then subjected to gradually increasing heats to the top of the superheater. This method worked well with the easily volatilized naphtha then in use, but, with the advent of the more refractory oils, it was found that there was something radically wrong. A season of experimenting elicited the fact that the notions held up to that time were entirely wrong,

and that the oils should be cracked up at a high heat, and then pass out through gradually decreasing temperatures.

Perhaps one of the greatest strides in economical operation of water gas sets made in a number of years is the method devised for measuring the air and steam supplied to the generator. Up to within a couple of years, the handling of the apparatus was a matter of cut-and-dry, pure and simple. If good results were obtained, it was a matter of guesswork as to why they were good; and if they fell off, the operator did not know in which direction to move to reproduce his former conditions. Feeling the need of some way of determining the exact conditions in the apparatus the system shown in the cut was devised. The method is an adaptation of the Venturi meter, and consists of such a meter for the generator blast, and similar ones on a small scale for the steam connections. By the use of these devices, together with suitable pyrometers, the operating conditions may be varied at will, any desired set of conditions held as long as desired, or, if changed, can be positively returned to at any time. This arrangement takes the water gas apparatus out of the rule-of-thumb class and makes of it a scientific machine.

Opposition to Water Gas.—From the first, the introduction of water gas met with strong opposition from the unthinking or conservative, or from those having personal interests at stake. As far back as 1854, Pelouze made a report to the Municipal Council, of Paris, condemning the Kirkham process on account of the large quantities of carbonic oxide in the gas made by it.

As water gas dropped out of sight, the strictures on it ceased until the late 70's and early 80's. Then, as it was gradually introduced, the storm broke out afresh, and became intensely bitter, the feeling, no doubt, being heightened by some of the methods of those interested in its introduction. Statements and misstatements were made on both sides, and the question of allowing its manufacture and distribution came up in several state legislatures. In Massachusetts, a law went into effect (1880) limiting the amount of carbonic oxide in gas to 10 per cent., and, of course, effectively prohibiting manufacture of water gas. By degrees, however, the fact that the consumers in those places where it was permitted were rather better off than those who were limited to straight coal gas became appreciated, and the opposition died away. In Massachusetts the carbonic oxide law was repealed in 1890, and since then only sporadic eruptions of opposition have occurred.

The first practical introduction of water gas in England being in 1890, when a plant was erected at the Beckton works, London, the opposition to it came later than in the United States. The question was finally settled, however, after a most searching investigation by a Parliamentary committee, by dropping the whole question.

In Germany and Holland there are no restrictions whatever, except that the gas shall have enough enrichment to give it an odor so that its presence may be detected in case of leak. As a matter of fact, there are a number of small towns in both countries sending out a straight, blue, water gas with a small amount of benzol vapor injected into it when cold.

In France, many of the old concessions specify that the gas shall be made from coal; permission to make water gas can, however, be obtained as was done in Lyons, Marseilles, Nice and St. Quentin.

Growth of Water Gas.—From the time of the introduction of the Sanders apparatus, in 1858, the manufacture of water gas has assumed gigantic proportions. From this small beginning, the number of works in the United States in 1907 making water gas was 520, manufacturing over one hundred billions of cubic feet; while in the same year there were 510 works making coal gas, with an output of but fifty-eight billions of cubic feet.

It is a curious coincidence that the first practical introduction of water gas was almost coincident with the first issue of the American Gas Light Journal, whose fiftieth birthday we are in this issue celebrating. From weak and puny infants, water gas and the American Gas Light Journal have grown to be strong influences in the gas industry and to have gained the respect of all.

Before closing, acknowledgment should be made of the information contained in this paper to Mr. F. H. Shelton, who, in 1889, read before the American Gas Light Association a history of "Illuminating Water Gas—Past and Present"; to Dr. A. C. Humphreys, who, in the same year, prepared for the British Association for the Advancement of Science a paper, "Water Gas in the United States"; to the "Progressive Age," which, in 1894, published an article covering the history of water gas from the time of Mr. Shelton's paper to that date; and to the various other journals which furnished the necessary data for this history.

The Development of the Public Utilities Commissions as Applied to the Gas and Electric Business.

[Prepared by Mr. C. J. Russell Humphreys, Lawrence, Mass.]

As a preliminary to the study of the development of the supervision of the gas and electric business by state commissions, it is necessary to consider—but it must be in a very brief way—some of the conditions surrounding these industries during the latter part of the last century, and to note that in some cases the conditions under which these companies did business were far from satisfactory. These circumstances led the managers of some of the corporations engaged in the lighting business to feel that supervision of the industries by the State on the lines of a regulated monopoly might place the business on a more stable and satisfactory basis. If we go back of the period when electricity first came into the lighting field as a factor, the power and importance of which could not then be correctly judged, we find the supply of artificial light in the control of the gas companies, with no competition of any prominence, until kerosene loomed up with its claim to share in a large measure the lighting business with the gas companies.

In those early days, competition prevailed between gas companies in some of the larger cities, but the opinion was generally held in smaller places that the business that could possibly be obtained in a moderate sized city did not offer an inducement for a competing gas company to enter the field for the purpose of obtaining a share of the lighting. Many present-day adherents of State control of public utilities hark back to those old days and cite instances where gas companies, feeling sure of a practical monopoly of the gas business, charged exorbitant prices for their product, gave poor service to their customers and acted generally in an arbitrary way; such cases certainly did exist. That there were some gas companies where the managers felt that their greatest opportunities lay in the direction of securing the most for their product and spending as little money as possible in the extension and upkeep of their plants cannot be gainsaid; but it is not just that this charge should lay against the gas business as a whole, for such instances were the exception and not the rule. The general practice and method of management of a company well conducted are quickly forgotten by the public-at-large, whereas matters of comparative little importance in themselves are long remembered on account of unpleasant mannerism or arbitrary ruling that is linked to the episode. These unpleasant incidents have been quoted time without number by those who would criticize the management of gas companies of those early days, until those who know of such matters only as they have heard of them from these criticisms accept them as applying to the gas business at large as conducted in those days. There is, moreover, another thought well worth keeping in mind, and it is this: that, in considering the methods pursued in the gas business of 50 years ago, we should keep in mind its environment. Commercial affairs were not conducted half a century ago as they are now. Business ran on small lines in those days. Now, everything is on a huge basis. Therefore, in judging of the conduct of the gas business as it existed half a century ago, we must consider as a background the business affairs and the general lines upon which commerce was carried on during that period.

In the early seventies, certain movements were on foot that indicated troublous times for the gas industry. Many patents were being taken out for the manufacture of gas by different processes, and the owner of these rights adopted the cry of cheaper gas. The public at that time did not appreciate the relation of the cost of gas in the holder to the cost as delivered to the consumer, and the claims that were made by the advocates of new processes, that gas could be made for a given figure, produced the impression very generally that this figure, which was really meant to cover only the cost in the holder, was the total cost to the companies, and that, therefore, the profit to the companies was the difference between their selling prices and these estimated costs which were really only manufacturing figures. The sentiment, therefore, grew, that the gas companies were making exorbitant profits, and public sympathy was largely given to those who were trying to establish rival companies on the basis of these new processes. As time went on, and these new schemes of manufacturing were taken up by syndicates and exploiters, gas companies found themselves threatened by competition of a very serious nature. In many instances, such competing companies were formed and came into active operation. In other cases, the existing companies bought up the rights for these new schemes. At that time, in many States, all a rival

company had to do was to secure the consent of the mayor of a city, or of the selectmen of a town, in order to lay its pipes in the streets and take up the work of competing with the established companies. The cry of competition was naturally popular, and everywhere the saying was heard that "Competition is the life of trade." But be it said to the credit of many municipalities that a broader view was taken of the problem presented to them, for they could not but foresee that competition in such a business meant ultimately combination of warring interests, and that eventually the public would have to pay interest on this increased investment. On many occasions, when hearings were held on the competition of would-be rival companies, the adherents of established concerns would bring forth their saying that, "Where combination is possible, competition is impossible." For many years these two sayings, "Competition is the life of trade", and, "Where combination is possible, competition is impossible", were constantly used for and against the interests of the new companies. As from time-to-time charters were given which led to competition in the supply of gas, the truth of the latter proverb was proven, and the public found that, while for a brief space of time reductions in the price of gas prevailed, that period was quickly followed by a combination of the two companies, and the price of the product was raised to meet the interest on this double investment, so that the public had little to see in return for the trouble and inconvenience it had experienced in allowing the streets to be dug up for the laying and maintenance of a duplicate distributing system.

It was naturally to be expected that conservative Massachusetts would look upon this new problem of proposed competition in business of this nature in the broadest and most independent way, and the applications of these rival companies were examined into with considerable care. Generally, hearings were given before the proper municipal authorities, and the printed volumes of these investigations indicate not only the thoroughness with which the subject was considered, but also afford to-day, by the testimony of those who appear for or against the established companies, a valuable insight into the condition of gas affairs in those days. When the subject was thus thoroughly investigated on its merits, competition made but little headway, and we may note the cases of the Suffolk and Shawmut Company, of Boston, the Citizens' Gas Light Company, of Boston, and the Citizens' Gas Company, of Lowell, as instances in point where the printed proceedings of the hearings show the completeness with which the question was considered, and incidentally the bulky volumes give us many valuable sidelights on the gas business of those days.

In 1875 the Board of Aldermen of Boston passed two votes, one supplementary to the other, requesting the Mayor of the city to appoint three Commissioners to report on the quality and price of gas furnished in that city in comparison with other cities in this country and Europe; whether any improvements could be made in the method of gas manufacture in the city; whether it would be expedient for the city to undertake the manufacture of gas; and, lastly, whether any further legislation is desirable to insure gas consumers a prompt and impartial investigation of complaints against the companies.

The Commissioners appointed under this order reported the following year. The document is too long to review, but there are certain paragraphs contained therein worthy of attention at this time. The Commissioners studied the gas situation in Boston, and in many other cities; investigated the different processes for manufacturing gas, and studied the effects from competition in the supply of gas in other cities. The following abstracts from this report are worthy of quotation, as indicating the tendency of the line of thought upon the part of thinking men:

"The relation of the public to the gas companies does not materially differ from its relation to the railroad corporations. It is practically dealing with what, from the nature of things, must be a monopoly. The manufacture and sale of gas are not to be considered similar to other branches of manufacturing. When extraordinary profit is realized from other branches of manufacturing, new capital is attracted and profits find their level. New gas companies cannot be established within the same territory. Competition is not to be relied on to control prices in the manufacture and sale of gas any more than in the reduction of transportation charges on railroads. Competition in each case is only incidental, and while railroad and gas corporations may for a time engage in competition, it is only for the purpose of eventual combination in which the public interest must suffer."

"What is needed is the establishment of a permanent board of competent men, who shall make it their business to become acquainted with the business of manufacturing gas, and with the operations of the various companies engaged in the manufacture within the State. The corporations should be required to make returns semi-annually of all their doings to this board, as fully as London companies are required to. The board should be required to make frequent inspection of the quality and purity of the gas furnished by the different companies, and make public from time to time the results of their inspections. It should be empowered to investigate all complaints against gas companies by their customers. It would not be necessary, and perhaps not wise, to give such a board compulsory power to enforce its decrees. It should be rather an advisory board, with sufficient knowledge of the subject to understand fully the matter with which it is dealing."

"We would advise the City of Boston to petition to the Legislature of Massachusetts for the appointment of a permanent board of commissioners, similar to the Railroad Commissioners, who shall have authority to thoroughly inspect the gas of all the companies in the State, and also through a competent auditor to examine all of the accounts of the companies."

There came a time, however, in the early '80s, when Boston departed from its ways of conservatism and wisdom, which finally resulted in the city's gas affairs being thrown into a very chaotic condition—a state of affairs that required fully 20 years to straighten out. At that time, the city proper was supplied by the Boston Gas Light Company, while in the outlying districts the Roxbury, Dorchester, South Boston and Brookline companies operated. Each company confined itself to its own territory, and the relations between the several corporations were harmonious. This condition of affairs was rudely shaken in 1884, when the Consumers' Gas Company, of Boston, applied to the aldermen of that city for a franchise to lay pipes in the streets. This measure passed the board, but was vetoed by the Mayor. At this time, the late Mr. W. W. Greenough, for years the leader of gas matters in Massachusetts, was the treasurer and agent of the Boston Gas Light Company, and his son, Mr. Malcolm S. Greenough, who is so well known in the gas industry both here and abroad, was manager of the Company. At the time Mr. M. S. Greenough took up the work as Manager of the Company, the plant of the Gas Company was at the north end of the city—the North End Station, as it has since been called—in a district that was then growing up rapidly, and it was apparent that another site must be found for a new station. Commercial Point, at Dorchester, was selected for the new plant, and the station has since been known as the Commercial Point Station. This new plant was nearing completion when the Consumers' Gas Company applied for their franchise. There was, therefore, every reason why the city should have seen that with the Boston Company's new plant coming into operation, it was not for the city's interest to sanction a further capitalization for a new company. But the folly of the aldermen at this time was rendered harmless by the action of the Mayor.

At the time when the Consumers' Gas Company was before the Board, Mr. M. S. Greenough was a member of that body. When the petition of the Consumers' Gas Company was defeated by the action of the Mayor, Mr. M. S. Greenough, in order to show the willingness of the Boston Gas Company to submit itself to the supervision of the State, introduced in the Board of Aldermen the following order, which is taken from the minutes of the meeting of the Board, September 19, 1884: "Alderman Greenough offered an order that his Honor the Mayor be requested to petition the General Court at its next session for the appointment of a State Gas Commission, the expenses of which shall be assessed upon the gas companies of the Commonwealth in proportion to their valuations, which shall have duties similar to those exercised by the Railroad Commissioners, in that the gas companies shall be obliged to make annual returns to the Commonwealth, showing the amounts of their profits, etc., and the Commission shall have power to investigate all charges brought against any company which shall be properly brought before it in regard to the quality or the price of the gas furnished, and shall report its findings thereon to the General Court."

Thus, Mr. Greenough, who was an Alderman of the city, and also the Manager of the Boston Gas Light Company, became a sponsor for the new theory of State supervision of gas companies. It is not likely that Mr. Greenough took this action with-

out careful thought. He had noted the unsatisfactory condition of the gas business in other cities. He must have seen that, from the standpoint of his dual position, it was essential that the gas problem must be met by some other method than competition, and it was necessary that some system should be established by means of which the public would be disabused of its unjust opinions regarding gas companies, based upon ignorance and the false statements made by the advocates of rival companies, whose only road to success lay in traducing the established gas companies, and thus creating a sentiment in favor of competition.

This same line of reasoning had doubtless been working in the minds of other managers of gas companies and public men, but it needed some one to take the initiative. This was indicated by the general interest shown in the measure when it came before the Legislature. The petition of the Mayor, with an accompanying bill drawn by the City Solicitor, when received by the Legislature, was referred to the "Committee on Public Service". This bill, as presented, did not give the Commission any power to prevent competition in the gas business, and hence was not acceptable to the gas interests. An amendment was, therefore, introduced to the effect that, in any city or town in which a gas company was in active operation, no other company could open the streets for the purpose of laying gas pipes without the consent of the municipal authorities, and the approval in writing of the Commission. This amendment was adopted into the bill, but later the portion referring to the approval required of the commission was stricken out, and the bill was restored to its former state, leaving the commission with no authority to prevent competition. However, before the bill was enacted, Section 16 was added, giving to any gas company aggrieved by the action of a municipality in granting an application of a would-be competing gas company the right to appeal from such decision to the commission; thus restoring to the bill the power of the commission to control competition. This section No. 16 is later quoted in full. Many hearings were held before this committee, and while there were some to advocate the adoption of the bill, there were also others opposed to it.

This opposition being largely, directly and indirectly, from those who were preparing to start rival gas companies in different cities of the Commonwealth. Mr. Charles P. Greenough, brother of Mr. Malcolm S. Greenough, was the counsel of the Boston Gas Company, and he bore the laboring oar in the effort to secure a bill that would be fair to the public and just to the gas companies. The public utilities of to-day owe much to Messrs. Greenough for their work of 1885, which resulted finally in placing on the statute books a law which, while it is ample in its provisions to safeguard the public interest, is at the same time drawn on lines which a manager of a gas company can work under without sacrificing his self-respect—a phase of the subject which is of vital importance, but has been lost sight of, or purposely ignored in drawing like bills in some other States.

It was not destined, however, that the Boston Gas Light Company was to benefit by this bill, for the Bay State Gas Company, of Boston, which was incorporated December 2, 1884, was making every effort to secure a franchise from the Boston aldermen before the commission bill could become a law. The opposition of those who did not wish to have the bill passed and the efforts on the part of others who were anxious that the bill, when enacted, should be just and fair to all parties in interest, led to considerable delay in the passage of the measure, so before it was finally enacted, the Bay State Gas Company, of Boston, had secured its franchise from the Boston aldermen. How different might have been the condition of gas affairs in Boston, and, in fact, throughout the State, if this bill had passed promptly to enactment.

The Act, known as Chapter 314 of the Acts of 1885, finally passed the Legislature and was approved by the Governor, June 11, 1885. The title of the Act is, "An Act to Establish a Board of Gas Commissioners." I should like to reproduce the Act *in extenso,* as it was the first law passed in any State placing the gas companies, and later the electric companies, under State supervision, but lack of space will compel me to omit or abbreviate those sections which are of a perfunctory character.

Section 1 instructs the Governor, with the consent of his Council, to appoint three citizens who shall constitute a Board of Gas Commissioners, the Governor to designate the chairman.

Section 2 defines the term of office of the Commissioners, full term being three years.

Sections 3, 4 and 5 deal with matters pertaining to the qualification of the Commissioners, their salaries and expenses.

Sections 7, 8, 9, 10, 11, 12, 13, 14, 15 and 16 are as follows:

"Sect. 7. Every gas company shall annually make a return to said board in a form and at a time prescribed by said board, setting forth the amount of its authorized capital, its indebtedness and financial condition on the first day of January preceding, and a statement of its income and expenses during the preceding year, together with its dividends paid or declared, and a list containing the names of all its salaried officers, and the amount of the annual salary paid to each; and said return shall be signed and sworn to by the president and treasurer of said company and a majority of its directors. Every such company shall also at all times on request furnish any statement or information required by the board concerning the condition, management and operations of the company, and shall comply with all lawful orders of said board.

"Sect. 8. Said board shall have the general supervision of all corporations engaged in the manufacture and sale of gas for lighting and for fuel, and shall make all necessary examinations and inquiries and keep themselves informed as to the compliance of the several corporations with the provisions of law.

"Sect. 9. Upon the complaint in writing of the mayor of a city or the selectmen of a town in which a gas company is located, or of twenty customers of such company, either of the quality or price of the gas sold and delivered by such company, the board shall notify the company of such complaint by leaving at their office a copy thereof, and shall thereupon, after notice, give a public hearing to such petitioner and such company, and after said hearing may order, if they deem just and proper, any reduction in the price of gas or improvement in quality thereof; and they shall pass such orders and take such action as are necessary thereto, and a report of the proceedings and the result thereof shall be included in their annual report to the legislature.

"Sect. 10. In any city or town in which a gas company exists in active operation, no other gas company, nor any other persons, shall dig up and open the streets, lanes and highways of such city or town, for the purpose of laying gas pipes therein, without the consent of the mayor and aldermen or selectmen of such city or town, after a public hearing before said mayor and aldermen or selectmen and notice to all parties interested by publication or otherwise.

"Sect. 11. The board shall from time to time ascertain with what degree of purity the gas companies can reasonably be required to make and supply gas; and if any change in the existing laws requiring purity in gas shall be in their opinion desirable or expedient, they shall so report to the legislature in their next report.

"Sect. 12. The board, whenever any such company violates or neglects in any respect to comply with the provisions of any law, or refuses or neglects to comply with any lawful order of the board, shall give notice thereof in writing to such corporation, and to the attorney-general, who shall take such proceedings thereon as he may deem expedient.

"Sect. 13. Any court having jurisdiction in equity, in term time or vacation, may, on the application of said board, by any suitable process or decree in equity, enforce the provisions of this act and the lawful orders of said board.

"Sect. 14. The board shall make an annual report of its doings to the legislature in January, with such suggestions as to the condition of affairs or conduct of the gas companies as may be deemed appropriate.

"Sect. 15. Nothing in this act shall affect the office of gas inspector as constituted by chapter sixty-one of the Public Statutes, excepting that said inspector shall whenever requested by the board give to them such information and assistance as they may require, consistent with the duties of his office.

"Sect. 16. Any gas company which, or any person who, is aggrieved by the decision of the mayor and aldermen or selectmen of a city or town under the provisions of the tenth section of this act, may appeal therefrom to said board within thirty days from the notice of said decision, and said board shall thereupon give due notice and hear all the parties in interest and its decision thereupon shall be final."

The gentlemen appointed under this act, as the first board of gas commissioners of Massachusetts, were Starkes Whiton, Edward T. Rowell and Forrest E. Barker. Mr. Barker has served continuously on the Board from the time of his first appointment, July 16, 1886, and is now the very able and efficient Chairman of the Board.

That the members of this, the first board of commissioners, felt the difficulties confronting them on assuming office, is per-

haps indicated by the following extracts taken from the first annual report of the Board.

"While Great Britain has for a long time exercised a close supervision over the gas companies of that country, no similar board, so far as the commissioners are informed, has ever existed in the United States. Under these circumstances the commission was compelled to fix upon its own course of procedure without the benefit of the experience of others. It has, therefore, endeavored by careful study and inquiry to prepare itself for intelligent action regarding the corporations under its supervision, and the relations of the people with them."

It is interesting to turn to other portions of this, the first annual report of the first State Gas Commission, and note the comments of the board on certain phases of the problem of gas administration.

Under the head "Price of Gas", the commission says in part: "The cost of making and distributing gas is perhaps more dependent upon the amount made and sold than that of almost any other commodity. Hence it is claimed that one company in any locality, provided it have sufficient appliances of the best kind, can make and deliver gas at a lower price than can be done by two or more companies in the same territory, with the same consumption but with the inevitable increase of capital for duplicate plant, and the expense of additional superintendence.

"For these reasons, and for others growing out of the peculiar difficulties incident to the business itself, after a separate, perhaps hostile existence for a longer or shorter time, companies seeking their customers in the same city have thought it for their own interests to combine or consolidate, or by mutual understanding to confine their business to distinct districts. * * *

"It is not true, however, that the price of gas to the consumer bears a definite and constant relation to the cost to the company. Some companies have seemed to prefer a small consumption at a high price, assuring good dividends, to an increased consumption at a lower price, with no greater dividend. Many expedients have been adopted by local authorities and legislative bodies to secure fair treatment to consumers, and a good quality of gas at a price fairly proportionate to its cost. These efforts have for the most part failed of success.

"Competition has been allowed and encouraged; but after a season of ruinous rates the companies have combined, and consumers have been compelled to provide good dividends for the extra capital employed. To insure lasting competition, companies have been chartered and forbidden by statute ever to consolidate with another company in the same locality; with the result, however, that after a time friendly owners have secured a controlling interest in both companies, and competition has ceased. It cannot be expected that two companies will long continue to ruin themselves for the benefit of the public.

"It may fairly be presumed that under similar conditions the same kind of gas may be made and sold as cheaply by one company as another; and this significant fact may account in part for the failure of competition to secure for its promoters the results so earnestly sought. Whether the processes recently invented give well-grounded promise of more successful competition, involves the consideration of a long and confusing array of facts, which this board has not yet had the opportunity to thoroughly investigate. * * *

"It remained for this Commonwealth to adopt the most comprehensive scheme of State supervision yet devised for the protection both of the companies and the public. By such modifications of this plan, as from time to time may seem advisable, it should be possible to secure not only a just and proper relation between cost and price in every locality, but also to insure the adoption of such methods and appliances in manufacture as will produce the best quality of gas at the lowest cost."

Beginning with the original statutes of 1885, under which the Board of Gas Commissioners was appointed, it may be of interest to follow along, in a brief way, the succeeding acts relating to the powers of the commission, and note how its authority over the lighting interests has been extended from time to time.

In the year following the appointment of the Board—that is, in the year 1886—an act was passed by the Legislature, of which I quote Section 1 in full:

"Every gas company shall have an office in the city or town in which its works are located, and shall keep in said office all the books and papers now required by law to be kept within the Commonwealth, and also such books as may be required to show its receipts and expenditures, and its indebtedness and financial condition; and shall at all times, upon application, submit its books to the inspection of the Board of Gas Commissioners."

The second section of the same statute calls upon the gas companies throughout the State to close their books on the 30th day of June each year, and to make their returns to the gas commissioners according to a form to be compared by the board. Under the same act, any person who is aggrieved by the refusal or the neglect of the gas company to supply him with gas is given the right to apply to the board, which is empowered to issue an order directing and requiring such a company to supply the aggrieved person with gas under such terms and conditions as are legal and reasonable.

During the year 1887, the Legislature passed an act extending the supervision of the board to companies engaged in the manufacture and sale of electric light. The Legislature also changed the name of the board at this session, giving it the title of "The Board of Gas and Electric Light Commissioners," thus indicating more clearly the scope of the board's authority. It is of interest to note Sections 3 and 5 of this act, as bearing on the question of preventing competition in cities or towns where at that time electric light companies were already established, the term company being defined in the act to include "All corporations or individuals engaged in the business of manufacturing or selling electric light in the Commonwealth."

"Section 3. In any city or town in which a company is engaged in or organized for the purpose of the manufacture and sale of electric light no other company shall lay or erect wires over or under the streets, lanes and highways of such city or town for the purpose of carrying on its business without the consent of the mayor and aldermen of such city or selectmen of a town after a public hearing and notice to all parties interested.

"Section 5. Any company or person aggrieved by the decision of the mayor and aldermen of a city or selectmen of a town under the provisions of the third section of this act may appeal therefrom to said board within thirty days from the notice of said decision, and said board shall thereupon give due notice and hear all persons in interest, and its decision thereon shall be final."

The protection afforded electric light interests by this act is a little broader than that covered by the acts of 1885 in reference to gas companies, as in the former instance in Section 10, it is stated, "In any city or town in which a gas company *exists in active operation,* no other gas company, etc." (The italics are mine.) Whereas, it will be noted in the case of electric light companies that the right of appeal would rest with the company *engaged in, or organized for,* the purpose of the manufacture and sale of electric light, thus giving the right of appeal to the gas commissioners from a decision of a mayor and aldermen of a city or selectmen of a town, who may have given a permit to a proposed electric company to do business in a city or town where an electric light company is organized, even though the company had not at that time commenced active operation.

At the same session of the Legislature, namely, 1887, an act was passed authorizing gas companies to furnish electric light after going through certain forms and securing the consent of the Board of Gas Commissioners. In the year 1888, the Legislature passed an additional law relating to the Gas Commissioners and their power over gas companies, which any company having had the rate of gas fixed by the Gas Commission was forbidden to increase the price, except upon petition to the Board of Gas Commissioners, and afterward securing their consent at a public hearing. The same act further decreed that all companies engaged in the manufacture or distribution of gas or electricity should report to the board any accidents by gas or electricity supplied by them.

No further legislation affecting the board was enacted until the session of 1892, when an act was passed requiring any city or town engaged in the business of manufacturing or distributing gas or electricity to send forthwith to the board certified copies of all votes and ordinances passed by the city or town relating to the gas or electric business. The Legislature of 1894 passed an act increasing very largely the power of the board by requiring that all gas and electric light companies should thereafter secure the consent of the board before issuing additional stock or bonds. The character of the legislation is indicated by the first section of this act, being Chapter 450 of the Acts of 1894:

"Sec. 1. Gas companies and electric light companies, whether such companies are organized under general laws or under special charters, and however authorized to issue capital stock and bonds, shall hereafter issue only such amounts of stock and bonds as may from time to time, upon investigation by the Board of Gas and Electric Light Commissioners, be deemed and

be voted by them to be reasonably requisite for the purposes for which such issue of stock or bonds has been authorized. The said board shall announce a decision within 30 days from the date of the last hearing upon the application of any gas or electric light company for permission to issue such stock or bonds. The vote of the board approving such issue shall specify the respective amounts of stock and bonds authorized to be issued for the respective purposes to which the proceeds thereof are to be applied. Any such decision and vote of the Board of Gas and Electric Light Commissioners shall be filed in writing in the office of said board within seven days after the rendering thereof, and shall assign in writing the reasons for the decision. A certificate setting forth the vote of the board shall within three days after said vote be filed in the office of the Secretary of the Commonwealth before the certificates of stock or the bonds are issued; and no company included in the terms of this act shall apply the proceeds of such stock or bonds to any purpose not specified in such certificate. Nothing contained in this act shall be construed as impairing any existing requirements of law in relation to the issue of capital stock or bonds by such companies, provided such requirements are not inconsistent herewith."

The Legislature of 1898 increased the compensation of the members of the board, so that the chairman would receive $4,000 and the other members of the board $3,500 each per year.

The Legislature did not pass any further acts, increasing or amending the powers and duties of the board, until the session of 1902, when a statute was passed "To transfer the powers and duties of the inspector of gas meters and of illuminating gas to the Board of Gas and Electric Light Commissioners." Prior to the passage of this law, the inspector of gas and meters was independent of the board. The duty of testing meters and inspecting the gas for candle power and purity had been performed by the gas inspectors and his assistants for many years before the appointment of the Board of Gas and Electric Light Commissioners, but by the passage of the above act, the inspection department was placed under the board, and thereafter the reports of the inspector of gas and meters was included in the report of the commissioners. The effect of this act was to give the board a more complete oversight of the quality of gas sent out by the several companies throughout the State.

At the session of the Legislature just closed, an act was passed which will throw additional work upon the Gas and Electric Light Commission. The new law deals with the testing of gas and meters, the most important clause being that relating to sulphur other than sulphuretted hydrogen. The law, as it existed prior to the passage of the bill just enacted, provided that the gas should not contain more than 20 grains of sulphur per 100 cubic feet. The law was non-elastic; if through unavoidable causes the sulphur limit was exceeded a fine was imposed. The purpose of the present act is to allow the commission to fix the standard for sulphur, but not to exceed 30 grains per 100 cubic feet. This portion of the act is as follows: "The Board of Gas and Electric Light Commissioners shall, for the purpose of establishing a standard of purity for gas, and after a public hearing, determine how many grains of sulphur and ammonia per 100 cubic feet of gas may be permitted, and the board shall have power to change such standards from time to time, after a public hearing; but not more than 30 grains of sulphur per 100 cubic feet, and no sulphuretted hydrogen shall be allowed." The act further provides that if the gas is below the prescribed standard "Unless such defect is in the opinion of the board due to unavoidable cause or accident, a fine of $100 shall be paid by such company, city or town into the treasury of the Commonwealth," thus giving authority to the commission to abstain from imposing such fine if the law was broken through accident or unavoidable cause.

As indicating the variety of the work that falls upon the board, I might note the *resolve* passed by the Legislature of 1906:

"Resolved, That the Board of Gas and Electric Light Commissioners is hereby requested to investigate the feasibility and desirability of equipping gas fixtures with self-closing devices, including the cost and efficiency of such devices, and to report to the general court on or before the second Wednesday of January next, the result of such investigation, with such recommendations as the board may deem advisable."

From the foregoing notes, it will be gathered that the Legislature has from time to time added to and amended the original acts of the commission of 1885, increasing the general powers of the board over the gas business, and giving them also supervision over the electric light business, so that to-day the board would seem to possess all the power and authority requisite for the control of the companies engaged in the gas and electric business.

In addition to the acts which have been noted relating to the general powers of the board, the Legislature has from time to time committed many other subjects to the board for investigation and judication, such as bills to investigate the price of gas and the efficiency of the service in certain cities and towns; and to pass upon the consolidation of the several gas companies comprised in what is generally known as the Boston group which now constitutes the Boston Consolidated Gas Company; as well as to investigate such matters as electric meters and certain kinds of gas fixtures. All these acts and resolves have, with the general duties of the commission, made it one of the busiest boards in the Commonwealth. While at times the Legislature has shown a tendency to legislate directly on certain matters in connection with the business under the control of the commissioners, it has in general held to the theory that as long as there is a State Board of Gas and Electric Light Commissioners, subjects of importance relating to these industries should be referred to the board, either with power to act in the matter, or with instructions to report to the Legislature. It is particularly to be noted during the present session of the Legislature, when bills were introduced to reduce the price of gas in certain cities, although the supporters of these bills made every effort to pass the acts, the final outcome was the defeat of the measures, with, perhaps, the general understanding that the subject treated of would be considered by special petitions from the cities in question to the gas commissioners. Such a policy on the part of the State tends to increase, and rightly, the standing of the board, and it is certainly to the advantage of all parties and interests that such matters, as proposed changes in the price of gas, or other subjects of like nature, should be considered by a body of experts, such as the Board of Gas and Electric Light Commissioners, rather than that they should be passed upon hurriedly in the Legislature by men who have not made a special study of the lighting business. It certainly may be said that the method of control of the gas and electric companies in this State is now on a very satisfactory basis, as the present members of the Board of Commissioners have served so long in office that they are fully acquainted with the details of the business committed to their charge, so that, on the one hand, the public is protected in all its rights, while, on the other hand, following the general and special policy of the State, the companies are practically protected against competition, as long as they appear to fulfill their duties to the public.

The present members of the board are: Forrest E. Barker, appointed to office in 1886; Morris Schaff, appointed in 1893, and Alonzo R. Weed, who came into office in 1906.

The year 1905 saw a strenuous time for the lighting interests of New York State. On March 30 of that year, a committee of the New York Legislature, appointed to investigate the affairs of the Consolidated Gas Company, began its hearing. From the first it was clear, to all those who were at all in touch with the situation, that the committee would very thoroughly probe the affairs of the Consolidated Company, and there was a very general feeling, caused, no doubt, by the attitude assumed by certain of the newspapers of the city, that the committee would, in the end, report in favor of making a reduction in the price of gas. The managers of other lighting companies throughout the State were fearful that the decision rendered by this committee, made up of a body of men who were not experts in the lighting interests, would be influenced rather by popular clamor than by regard to the real facts in the controversy. Moreover, it was generally hinted that, as the result of the committee's investigation, a Board of Gas Commissioners would be appointed by the State. The matter became of such general interest that the executive committee of the Empire State Gas and Electric Association considered the whole question carefully, and, hoping that the lighting interests might secure a less drastic law if the association moved in the matter, it prepared a draft of a bill which they hoped would pass the Legislature. The main point of the suggested act was, on the one hand, to give the proposed commission supervision of the lighting interests with power to control the price of gas, and at the same time to protect the established companies against competition, and to minimize the danger which threatened the industry by the establishment of municipal lighting plants. In a matter, however, of this kind where corporations openly propose legislation affecting their interests, it is very likely that the laws finally enacted will be very different in scope and bearing from the measure originally suggested. But be this as it may, the Legislature of New York, June 3, 1905, passed an act creating the Commission of Gas and Electricity, from which I take the following clauses which show briefly the nature and scope of the statute. I will give the sections either verbatim, or briefed, as the importance of the same may seem to require:

Section 1 gives the name of the Commission.

Section 2 defines the terms used in the act.

Section 3 states that the Commission shall consist of three members to be appointed by the Governor, with the consent of the Senate, the term of office to be three years.

Section 4. No person shall be eligible to office who is connected with, or owns stock or bonds in a gas or electric company,

Section 5 places the headquarters of the Commission in Albany, and deals with other office details.

Section 6. Two Commissioners shall constitute a quorum; hearings may be held by one Commissioner.

Section 7 gives the Commission power to appoint officers, clerks, and experts.

Section 8 places the salary of each Commissioner at $8,000 a year, and gives the Commission power to fix the salaries of the employees.

Section 9. "Such commission shall: 1. Have the general supervision of all persons and corporations having authority under any general or special law to lay down or erect and maintain wires, pipes, and other fixtures in, over or under the streets, highways and public places of any municipality in this State, for the purpose of furnishing gas or of furnishing or transmitting electricity for light, heat or power.

2. "Investigate and ascertain from time to time the quality of gas supplied by persons, corporations or municipalities; examine the methods employed by such persons, corporations or municipalities in supplying gas and electricity for light, heat and power or in transmitting the same, and order such improvements as will best promote public interests, preserve the public health and protect those using such gas or electricity, and those employed in the manufacture and distribution thereof, or in the maintenance or operation of the works, wires, poles, lines and systems connected therewith.

3. "Fix the standard of illuminating power and purity of gas manufactured and sold by persons, corporations and municipalities for lighting purposes, not less than that prescribed by law, and require the gas so manufactured and sold to equal the standard established by law or by it, and establish a standard of pressure at which gas shall be delivered, where such standard is not otherwise prescribed by law.

4. "Have power, in its discretion, to prescribe methods of keeping accounts and books, to be observed by the persons, corporations and municipalities, engaged in the manufacture, sale and distribution of gas and electricity for light, heat or power.

5. "Examine all persons, corporations and municipalities under its supervision, keep informed as to the methods employed by them in the transaction of their business, and see that their property is maintained and operated for the security and accommodation of the public and in compliance with the provisions of law and of their franchises and charters.

6. "Require each corporation under its supervision to submit to it an annual report, verified by the oath of the president, treasurer or general manager thereof, showing in detail (1) the amount of its authorized capital stock, the amount issued and outstanding; (2) the amount of its authorized bonded indebtedness and the amount of its bonds issued and outstanding; (3) its receipts and expenditures during the preceding year; (4) the amount paid as dividends upon its stock and as interest upon its bonds; (5) the amount paid as salaries to its officers and as wages to its employees; (6) the location of its plant and system, with a full description of its property and franchises; and (7) such other facts pertaining to the operation and maintenance of the plant and system, and the affairs of such corporation as may be required by the commission. Such reports shall be in the form, cover the period, and be submitted at the time prescribed by the commission."

Clause 7 of this section requires the commission to make an official report to the Legislature with abstracts of reports of the corporations made to it; recommendations as to modifications of the laws pertaining to the affairs of the corporations; and suggestions as to the better protection of the public interests and health in the transaction of business by such corporations.

Clause 8 gives the commission power either through the members or inspectors to enter the plants of the corporations under their supervision for purposes of inspection.

Clause 9 gives authority to examine the books and affairs of the companies and municipalities engaged in the gas or electric business.

Clause 10 gives power to the commission to subpœna witnesses.

Clause 11. "Have power to adopt rules governing practice in proceedings brought by or before it not inconsistent with law."

Section 10 gives the commission full power over the inspection of gas and electric meters by the State or municipal inspectors, and further vests them with authority to prescribe the manner, methods and conditions of testing such meters.

Section 11. *"Approval of Incorporation and Franchises; Certificate.*—A corporation hereafter incorporated under the laws of this or any other State for manufacturing and supplying gas for lighting the streets, highways and public places, and for heating and lighting public and private buildings, or for manufacturing, using, transmitting and supplying electricity for producing light, heat or power for public or private buildings or for lighting streets, highways and public places, shall not exercise any of its powers, or transact any business within this State, until it shall have secured a certificate of authority therefor signed and executed by the commission under its official seal. Before such certificate shall be issued a certified copy of the charter of such corporation shall be filed in the office of the commission, together with a verified statement of the president and secretary of the corporation, showing that it has received the required consent of the proper municipal authorities. The commission may inquire as to the necessity of the service to be furnished by such corporation, and as to the intentions and good faith of the corporation and its officers, and if satisfied that the territory within which such corporation proposes to operate is already supplied by an ample and well constructed system, furnishing the service which such corporation proposes to furnish, at a fair and reasonable rate, such commission may refuse to grant its certificate of authority. No municipality shall build, maintain and operate for other than municipal purposes any works or systems for the manufacture and supplying of gas or electricity for lighting purposes without a certificate of authority granted by the commission. If the certificate of authority is refused, no further proceedings shall be taken before the commission, but a new application may be made therefor after one year from the date of such refusal.

Section 12. *"Approval of Issue of Stock and Bonds.*—Stock or bonds shall not be issued by any corporation hereafter incorporated which is subject to the supervision of the commission, until the certificate of authority has been issued as required in the preceding section, and until such commission shall further certify, in writing, as to the amount of stock or bonds reasonably required for the purposes of the corporation. Stock and bonds of such corporation shall not be issued in excess of the amount so certified. Any such corporation heretofore or hereafter incorporated shall not increase its capital stock or its bonded indebtedness without the consent in writing of such commission, stating the amount of the authorized increase. For the purpose of making its determination as to the amount of stock and bonds to be issued or the amount of the authorized increase of the capital stock and bonded indebtedness of any such corporation, the commission may take and hear testimony, and examine the books and papers of the corporation, and require verified statements from the officers thereof, pertaining to the value of the property and franchises owned and operated by such corporation. Such determination shall be made within thirty days after the final submission of the papers or a final hearing on the application."

Section 13 forbids the transfer by a corporation of its franchise without the consent of the commission.

Section 14 gives the right of appeal to the Appellate Division of the Supreme Court if the commission refuses the certificate or authority required under provisions of sections 11, 12 and 13.

Section 15. On complaint of a mayor of a city, or trustee of a town, or of one hundred consumers regarding quality of service, the commission shall make an investigation.

Section 16 gives the form to be followed in making complaint under Section 15.

Section 17 prescribes a public hearing on such complaints and continues, "the commission, within the limits prescribed by law, may fix the maximum price of gas or electricity which shall be charged by such corporation or person in such municipality, or may order such improvement in the manufacture or supply of such gas or in the manufacture, transmission or supply of such electricity, or in the methods employed by such person or corporation, as will in its judgment improve the service. The price so fixed by the commission shall be the maximum price to be charged by such person or corporation for gas or electricity in such municipality for a term of three years and until, after the expiration of such term such commission shall upon complaint as provided in this section again fix the price of such gas or electricity."

Section 18 requires the commission to give reasonable notice to company interested before issuing orders on complaints.

Section 19 gives to any person or corporation aggrieved by any order made by the commission, the right, within thirty days after notice of the making of such order, to appeal to the Appellate Division of the Supreme Court.

Section 20 says that any order made by the commission as in this act provided may be enforced by writ of mandamus.

Section 21. A company cannot collect in court an amount based on a higher rate than that prescribed by the commission.

Section 22 provides appropriation for the use of the commission of the sum of $60,000.

Section 23. "This act shall take effect immediately."

The Governor appointed as the members of this commission Frederic E. Gunnison, John C. Davies and L. L. Shedden.

It certainly seemed unfortunate that this commission, made up as it was of men who had no particular knowledge of the gas and electric business, was called upon so soon after its induction into office to pass upon so large a question as the proper price for gas in the city of New York. The decision arrived at, after the investigation by the board, that the price should be 80 cents per 1,000 cubic feet, was probably the result of public clamor rather than due to a dispassionate study of the evidence presented at the hearing. The fact that the Legislature passed an act making the price of gas 80 cents, instead of leaving the whole matter in the hands of the appointed board, was not helpful in producing in the minds of all parties interested, a feeling of confidence in the gas commission. And this lack of confidence was increased by a decision of the Circuit Court of the United States, for the Southern District of New York, which reversed the decision of the Gas Commissioners on suit brought by the Consolidated Gas Company. The concluding clause of this decision, rendered December 19, 1907, is as follows:

"It results that the first prayer of the bill must be granted, upon the ground that both of the statutes involved as well as the order of the Commission of Gas and Electricity are in contravention of the 14th amendment of the Federal Constitution; and that the relief asked in the second and third prayers of the bill must also be granted."

It is true that on the final appeal of this case to the Supreme Court of the United States, that Court, under date of January 4, 1909, gave a decision reversing the decree of the Circuit Court, the closing paragraph of the decision being, "To that end, we reverse the decree with directions to dismiss the bill without prejudice."

While the decision of the Supreme Court may not be perfectly clear, the words, "without prejudice," would seem to leave it open to the Consolidated Company to bring the case up again if it might be proven from actual experience that the order of the commissioners was confiscatory.

While this commission was in power the Legislature passed several acts on subjects that should have been left to the Gas Commissioners. Among other matters thus passed upon by the Legislature was the establishing of the price of gas in Albany, and also the price of electricity in the same city, and fixing the price of gas and electricity and establishing the quality of the same in the city of Syracuse.

The existence of this commission was very brief. It may not be necessary to discuss here the reasons for this, but it was obvious that so long as the Legislature took direct action on matters that the State had put under the control of the commission, it was hardly to be expected that any of the parties in interest would place much reliance on the actions of the commission; but, be that as it may, the fact is, that the Legislature of 1907 passed a new bill, called the Public Utilities Bill, to take effect July 1 of that year, abolishing the Gas and Electric Light Commission, the State Railroad Commission, and the Rapid Transit Board of New York City, and vesting in the Public Utilities Commission the powers heretofore existing in these commissions, excepting so far as they were modified by the said Public Utilities Bill.

A large portion of this bill is naturally taken up with matters relating to the railroads and subjects referring to the rapid transit of New York City, and with these we have no occasion to deal. The State is divided by the bill into two sections. The first district includes the counties of New York, Kings, Queens and Richmond. The second district includes all other counties of the State. The bill provides that each of the commissioners be appointed by the Governor, with the consent of the Senate, the salary of each being fixed at $15,000 per year. The commission for each district shall consist of five members, the term of office to be five years.

I will not review the bill in detail, as many of the clauses run along the same general lines as the commission bill of 1905, with the exception that the 1907 bill deals with matters in greater minuteness. I will, however, note some of the important features of the act.

Natural gas companies are placed under the supervision of the commission. Sections 68, 69, and 70, dealing with the approval of incorporation and of stock issues and transfer of franchises, are as follows:

Section 68. "Approval of incorporation and franchises; certificate.—No gas corporation or electrical corporation incorporated under the laws of this or any other State shall begin construction, or exercise any right or privilege under any franchise hereafter granted, or under any franchise heretofore granted, but not heretofore actually exercised without first having obtained the permission and approval of the proper commission. Before such certificate shall be issued a certified copy of the charter of such corporation shall be filed in the office of the commission together with a verified statement of the president and secretary of the corporation, showing that it has received the required consent of the proper municipal authorities. No municipality shall build, maintain and operate for other than municipal purposes any works or systems for the manufacture and supplying of gas or electricity for lighting purposes without a certificate of authority granted by the commission. If the certificate of authority is refused, no further proceedings shall be taken before the commission, but a new application may be made therefor after one year from the date of such refusal."

Section 69. "Approval of issues of stock, bonds and other forms of indebtedness.—A gas corporation or electrical corporation organized or existing, or hereafter incorporated, under or by virtue of the laws of the State of New York, may issue stocks, bonds, notes or other evidence of indebtedness payable at periods of more than 12 months after the date thereof, when necessary for the acquisition of property, the construction, completion, extension or improvement of its plant or distributing system, or for the improvement or maintenance of its service or for the discharge or lawful refunding of its obligations, provided and not otherwise, that there shall have been secured from the proper commission an order authorizing such issue, and the amount thereof, and stating that, in the opinion of the commission, the use of the capital to be secured by the issue of such stocks, bonds, notes or other evidence of indebtedness is reasonably required for the said purposes of the corporation. For the purpose of enabling it to determine whether or not it should issue such an order, the commission shall make such inquiry or investigation, hold such hearings and examine such witnesses, books, papers, documents or contracts as it may deem of importance in enabling it to reach a determination. Such gas corporation or electrical corporation may issue notes, for proper corporate purposes and not in violation of any provision of this or of any other act, payable at periods of not more than 12 months without such consent; but no such notes shall, in whole or in part, directly or indirectly be refunded by any issue of stock or bonds or by any evidence of indebtedness running for more than 12 months without the consent of the proper commission. Provided, however, that the commission shall have no power to authorize the capitalization of any franchise to be a corporation or to authorize the capitalization of any franchise or the right to own, operate or enjoy any franchise whatsoever in excess of the amount (exclusive of any tax or annual charge) actually paid to the State or to any political subdivision thereof as the consideration for the grant of such franchise or right. Nor shall the capital stock of a corporation formed by the merger or consolidation of two or more other corporations, exceed the sum of the capital stock of the corporations, so consolidated, at the par value thereof, or such sum and any additional sum actually paid in cash; nor shall any contract for consolidation or lease be capitalized in the stock of any corporation whatever; nor shall any corporation hereafter issue any bonds against or as a lien upon any contract for consolidation or merger."

Section 70. "Approval of transfer of franchise.—No gas corporation or electrical corporation shall transfer or lease its franchise, works or system or any part of such franchise, works or system to any other person or corporation or contract for the operation of its works and system, without the written consent of the proper commission. The permission and approval of the commission, to the exercise of a franchise under Section 68 of this act, or to the assignment, transfer or lease of a franchise under this section shall not be construed to revive or validate any lapsed or invalid franchise or to enlarge or add to the powers and privileges contained in the grant of any franchise or to waive any forfeiture. No such corporation shall directly or indirectly acquire the stock or bonds of any other corporation incorporated

for, or engaged in, the same or a similar business, or proposing to operate or operating under a franchise from the same or any other municipality, unless authorized so to do by the commission. Save where stock shall be transferred or held for the purpose of collateral security only with the consent of the commission empowered by this act to give such consent, no stock corporation of any description, domestic or foreign, other than a gas or electrical corporation, shall purchase or acquire, take or hold, more than 10 per centum of the total capital stock issued by any gas corporation or electrical corporation organized or existing under or by virtue of the laws of this State. Nothing herein contained shall be construed to prevent the holding of stock heretofore lawfully acquired. Every contract, assignment, transfer or agreement for transfer of any stock by or through any person or corporation to any corporation, in violation of any provision of this act, shall be void and of no effect, and no such transfer or assignment shall be made upon the books of any such gas corporation, or electrical corporation, or shall be recognized as effective for any purpose."

Section 71 deals with complaints as to quality and price of gas and electricity, and methods to be followed by the commissions for investigating the same. It authorizes the bringing of complaints by 100 customers of the company complained of in cities of the first or second class, by 50 customers in cities of the third class or 20 customers in small places.

It might be noted here that one difference between this bill and the 1905 bill is the new power the board is given over the inspection of gas and meters. In the 1905 act, the board had supervision over the gas inspector of each municipality, while in the new law it oversees the inspection of gas and meters itself.

The members of these Public Service Commissions appointed by the Governor are as follows: For the First District, William R. Wilcox, Chairman; William McCarroll, Edward M. Bassett, Milo Roy Maltbie and John E. Hustes. This board has headquarters in New York City. The members of the Second District with headquarters at Albany are Frank M. Stevens, Thomas Mott Osborne, Charles H. Keep, James E. Sague and Martin S. Decker.

It is of interest to turn to the first annual report of these commissions to see how they are arranging to take care of such diverse and large interests as are committed to their supervision. Some idea of the responsibility resting upon this commission may be gathered from a brief extract from the first annual report of the Second District, that is, the district comprising all of the State outside of Greater New York.

"On the first day of July there were: Operating steam railroad corporations, 78; non-operating steam railroad corporations subject to its supervision and control but whose lines were leased to or operated by other corporations, 92; electric railroad corporations, 72; gas corporations, 119; electric light corporations, 211; joint gas and electrical corporations, 50; municipal light plants, 44; a total of more than 600 corporations subject to the supervision and regulation of this commission. The amount invested in railroad property thus subjected to the control of this commission is approximately $2,000,000,000, and of gas and electrical properties approximately $500,000,000; making approximately a total property valuation of $2,500,000,000 over which this commission is to exercise its great powers." For the proper handling of these interests, the work of the commission has been divided into six separate divisions. Of the first division, namely, that of heat, light and power, Henry C. Hazzard was appointed chief, with H. H. Crowell, gas and electrical engineer; C. H. Stone, chief gas inspector, and C. F. Hunter, chief electrical inspector.

The report calls attention to an order adopted by the former board June 15, 1907, establishing the standards of illuminating power and purity of gas at large throughout the State, "except as otherwise prescribed by law, at not less than 16 candles for coal gas, 18 candles for mixed coal and water gas and 20 candles for water gas." The order further provides that gas "Shall not contain more than 10 grains of ammonia nor more than 20 grains of sulphur per 100 cubic feet, and shall be free from sulphuretted hydrogen." Under electric meter inspection, the board calls attention to the fact that, after July 1st, all electric meters shall be inspected, approved and stamped by the commission, and that all corporations supplying electricity shall provide upon their premises apparatus for testing electric meters to be approved and stamped by the commission.

Turning to the first report of the commission for the First District, we find the commission has taken up in a comprehensive manner the subject of testing gas meters, and to help it in formulating rules for its inspectors, an expert was called in and his report is included in the commissioners' report. The commission has also instituted a system under which complaints regarding gas or electric service shall be made and investigated.

The length of service of these commissioners has not been such as to form a definite opinion as to the lines on which the work will be carried out, but the signs are of a hopeful character, and it is anticipated that the best possible judgment and a broad-minded policy will actuate the doings of these bodies.

Wisconsin is another State that has recently placed its public utility corporations under the control of a commission. This action had its inception in the inaugural address of Governor James Davidson, who, in the course of that portion of his address dealing with public service corporations, stated in part as follows:

"The only adequate remedy for excessive charges by public service corporations is the regulation of the rates by public authority. The Legislature may exercise this power directly or it may delegate the authority to any appropriate public agency. This doctrine, long recognized by the Supreme Court of this State, has been reaffirmed in the recent case of the City of Madison *vs.* Madison Gas & Electric Company. I recommend that the control and regulation of local public service corporations be granted to a State commission. * * * Public service corporations are entitled to secure a fair profit upon the actual cost of their properties, and no more. The valuation of the property, therefore, becomes an important factor in the problem of rate naming. Specific authority should be granted to the State commission to ascertain and determine the true cost of such properties, and to use this determination to aid in fixing a fair and just rate of compensation for services rendered."

The outcome of the recommendation by the Governor was the enactment by the Wisconsin Legislature of Chapter 499 of the Acts of 1907, the same being approved June 22nd of that year. The effect of the enactment of this chapter was to place the so-called public utilities under the supervision of the Wisconsin Railroad Commission.

The act defines a public utility as a corporation, company, individual, town, village, or city, that now operates, or may hereafter operate, a plant for the conveyance of telephone messages, or the production, transmission, delivery or furnishing of heat, light, water or power, either directly or indirectly to, or for the public. The law requires that every public utility shall furnish reasonably adequate service and facilities and that the charges for heat, light, water or power, or for telephone messages, or for any other service rendered, shall be reasonable and just.

That every public utility having conduits, subways, poles or other equipment on, or over the streets shall for reasonable compensation permit the use of the same by any public utility, whenever public convenience and interest require such use, and such use will not result in irreparable injury to the owner of such equipment; and in case of dispute in such a matter between the public utilities, the commission is given power to decide the questions involved, subject, however, to revision by the courts upon the complaint of either party aggrieved:

That the commission shall value "All the property of every public utility actually used or useful for the convenience of the public. In making such valuation, the commission may avail itself of any information in possession of the State Board of Assessment." Before making a final determination of such value, the commission shall give a public hearing to all parties interested: That every public utility shall keep its accounts and books according to forms prescribed by the commission.

Section 1797-M-11 is certainly peculiar. It reads as follows: "No public utility shall keep any other books, accounts, papers or records of the business transacted than those prescribed or approved by the commission."

That the commission shall provide for the examination and audit of all the accounts of each public utility:

That every public utility shall carry an adequate depreciation account at such rate as may be determined by the commission. The rate so established "Shall be such as will provide the amounts required over and above the expense of maintenance, to keep such property in a state of efficiency corresponding to the progress of the industry. * * * The commission shall provide for such depreciation in fixing the rates, tolls and charges to be paid by the public." The depreciation fund may be expended "In new constructions, extensions or additions to the property of such public utility, or invested, and if invested the income from the investments shall also be carried in the depreciation fund".

That "each public utility shall furnish to the commission in such form and at such times as the commission shall require, such accounts, reports and information as may be called for".

That the commission shall make an annual report of its proceedings, and shall show in such report the value of all property actually used and useful for the convenience of the public, of every public utility as to whose rates, charges, service or regulations any hearing has been held by the commission.

That the commission shall ascertain and fix adequate and serviceable standards for the measurement of quality, pressure, initial voltage or other condition pertaining to the supply of the product or service rendered by any public utility.

That the commission or its agents shall have power to enter upon any premises occupied by any public utility for the purpose of making examinations and tests:

That every public utility shall file with the commission upon their request a schedule showing all rates, tolls and charges which are in force, the same not to be in excess of the rates and charges in force April 1, 1907.

That the commission shall have authority to inquire into the general business management of all public utilities and keep itself informed as to the manner and method in which the same is conducted:

That the commission have power to appoint agents for the purpose of investigating any public utility, and such agent "shall have every power whatsoever of an inquisitorial nature granted in this act to the commission and the same powers as a court commissioner with regard to the taking of depositions; and all powers granted by law to a court commissioner relative to depositions are hereby granted to such agent".

That such commission shall, upon complaint of 25 persons or corporations, investigate the reasonableness and justice of the rates, and character of the service of any public utility, and the commission shall have power, if it finds such rates unjust, to order any rates or tolls, and in case of unjust, unreasonable or insufficient service, the commission may make such order respecting, and such changes in such service as shall be just and reasonable, and the commission may, if it shall believe that any rate or charge is unreasonable, investigate the same of its own volition with or without notice.

That if any public utility, or person or corporation in interest, is dissatisfied with any order of the commission fixing the rates, or tolls or regulations regarding service rendered by the public utility, the latter may commence action in the Circuit Court for Dane County to set aside such order on the ground that such order is unreasonable; such appeal, however, of the public utility shall be taken within 90 days after the entry of the order from which the appeal is taken.

That no license, permit or franchise shall be granted to any person or corporation to "Own, operate or manage or control any plant or equipment for the production, transmission, delivery or furnishing of heat, light, water or power in any municipality where there is in operation under an indeterminate permit as provided in this act a public utility engaged in similar service without first securing from the commission a declaration after a public hearing of all parties interested, that public convenience and necessity require such second public utility".

A similar section provides that a municipality cannot construct a plant "Where there is in operation a public utility engaged in similar service, without first obtaining from the commission a declaration after a public hearing of all parties interested, that public convenience and necessity require such municipal public utility." But this act does not prevent a municipality from acquiring any existing plant by purchase as provided in this act.

That "every license, permit or franchise hereafter granted shall be subject to the provision that the municipality in which the major part of the public utility plant is situated may purchase the property", paying therefor just compensation to be determined by the commission and according to the terms and conditions fixed by such commission. If a public utility or a municipality is dissatisfied with the award of the commission where a public utility is taken by a municipality, such party may apply to the circuit court to alter or amend such award. If the decision of the court is in favor of the commission, the terms, conditions and compensation fixed in the order of the commission shall stand; if the decision of the court shall be against the award of the commission, the court shall remand the case to the commission "With such findings of fact and conclusions of law as shall set forth in detail the reasons for such judgment and the specific particulars in which such order of the commission is adjudged to be unreasonable or unlawful". Upon receiving from the court such reversal of its award, the commission shall forthwith proceed to set a rehearing of the case; otherwise the commission shall forthwith alter and amend such previous order with or without a rehearing so that the same shall be reasonable and lawful in every particular.

This act is drastic in many of its features and possibly the wording of the act is unnecessarily irritating, a certain tone running through it which a self-respecting manager of a corporation cannot but resent. The clause forbidding a company to use any books, accounts, papers or records other than those prescribed or approved by the commission seems to be entirely unnecessary and aggravating. There are other features of the bill which should have been omitted or modified for the sake of harmonious working between the commission and the public utilities. The commission has formulated general orders regarding some details of the gas and electric service, doubtless the companies concerned will make every effort to comply with the regulations, but such compliance will be difficult for some of the corporations. The following is the rule adopted regarding the heating value of gas:

"The company furnishing gas which, within a one-mile radius from the distribution center, gives a monthly average total heating value of not less than 600 B. T. U., with a minimum which shall never fall below 550 B. T. U., may be considered as giving adequate service as far as the heating value of the gas is concerned."

"Each gas company, whose output exceeds 20,000,000 cubic feet a year, shall equip itself with a standard calorimeter outfit, with which periodic tests upon the gas shall be made. A record of these tests shall be made and kept open for public inspection."

No standard is fixed for candle power, as the commission feels it is of little value in comparison with calorific value; it is thought that the former will follow the latter close enough for all practical purposes.

The Legislature of Georgia, during the session of 1907, passed an act, approved August 20, 1907, enlarging the duties and powers of the railroad commission and placing under the supervision of the board telephone, telegraph, street railway, gas, electric and other companies. The membership of the board was increased to five members, all to be elected by the qualified voters of the State. This act does not call for any extended remarks, as it deals chiefly with railroads. Section 5 reads, "The power to determine what are just rates and charges is vested exclusively in said commission." This clause probably gives the commission power to regulate the prices charged for gas and electricity, although those companies are not mentioned therein, and in fact gas and electric corporations are seldom mentioned in the act, but undoubtedly are included in the blanket term occasionally made use of in the law "and other corporations, companies, or persons coming under the provisions of this act." The commission is given power to pass orders looking to the betterment of the service of the companies under its control, either of its own initiative or after a public hearing. The companies must secure the consent of the commission before issuing any stocks, or bonds, or notes payable more than twelve months after the date thereof.

The act does not touch on the important subject generally covered in other acts, namely, giving the commission power to pass on applications for franchises in places where public utilities are in active operation.

From the last annual report of the commission, just at hand, it is evident the commission has found little to do in relation to the gas and electric industries. It has not been necessary to try any case or issue any orders regarding gas services, and in only three instances have the electric companies been complained of, and these were small matters where the companies had refused to install electric meters.

The Legislature of Vermont, at its last session, passed an act changing the name of the Railroad Commission to the Public Service Commission, and adding to the duties of the board the supervision "Of all companies engaged in the manufacture, distribution and sale of gas or electricity for lighting or heating, of all express companies and of all companies owning or operating telegraph or telephone lines, stations or exchanges within this State.

"Said commission shall have power, so far as it is necessary for the performance of its duties, to examine the books, accounts and papers of any company * * * under its supervision."

A company subject to the supervision of the commission shall give the commission such information as it may request, regarding the affairs of the company, but such information shall not be made public by the commission, "Except as it may be neces-

sary in reports to the general assembly or in judicial proceedings."

The commission shall have jurisdiction in all matters respecting:

The purity, quantity or quality of any product furnished or sold by any company under its supervision.

"The manner of operating and conducting any business subject to supervision under this act, so as to be reasonable and expedient, and to promote the safety, convenience and accommodation of the public."

"The price, toll, rate or rental charged by any company subject to supervision under this act, when unreasonable or in violation of law."

"If, upon investigation, the commission finds the rates, tolls or charges to be unjust, unreasonable, insufficient or unjustly discriminatory," it may make such changes as are just and reasonable.

Section 14 is as follows:

"Any person or corporation aggrieved by any order or decision of the municipal authorities made under the provisions of any statute, relative to the granting of a license or permit for location, may at any time within 30 days of the date of such order or decision appeal therefrom to the Public Service Commission, and the decision of the commission thereon, after notice and public hearing of all parties interested, as provided in Section 8 of this act, shall be final, subject to a right of appeal to the Supreme Court, as herein provided."

The vagaries of law-making are apparent, when the above is compared with the last clause of the act, which is as follows:

"Nothing in this act or previous statutes shall be construed as giving the Public Service Commission power to prevent or restrict competition or limit the number of persons or companies who may engage in the business of furnishing light, heat, power, or any other business subject to supervision under the provision of this act in any town."

In some other States attempts have been made to enact some kind of a public utility bill, but generally the subject has excited little interest, although there have been instances where strenuous sessions have been held over this proposed measure. In Maine, it is stated several bills of this character have been introduced, but the subject developed little interest. The latest movement in this direction was to place the public utilities under the Railroad Commission, but the project did not meet with favor and the bill was dropped.

In Illinois a public utility bill has been introduced; the matter has not appeared to excite any enthusiasm. A bill of like nature was before the Legislature of Colorado last winter, but no action was taken on the measure. The Legislature of the State of Connecticut, which meets biennially, appointed a committee to consider, during recess time, the advisability of the State establishing a public utility commission. The board appointed to consider this subject was composed of business men and lawyers, serving without pay. At the beginning of the session of 1909, this committee or commission, reported to the Legislature recommending the appointment of a commission and submitting a proposed bill. This report was referred to the committee on the judiciary, which handed in a unanimous report recommending that no action be taken. Contrary to the usual course in such legislative matters, the recommendation of the judiciary committee was not adopted, but the subject was referred to a select committee of the Senate and House. This committee is now considering the matter.

In the Legislature of the State of Minnesota, there was introduced last year a bill entitled "An act defining public utilities, providing for the regulation thereof, and vesting the railroad and warehouse commission with jurisdiction over the same and for the regulation thereof." This bill followed very closely the lines of the Wisconsin bill, but there were some radical differences. One quite important one, was that it provided for placing the public utilities under a board already established, and that body is an elective one, elected by the people, whereas, under the Wisconsin act, the commissioners are appointed by the Governor.

There is a vast difference between these two methods of procedure. This bill failed of enactment, and it is certainly most fortunate that a bill giving such arbitrary powers over public utilities to an elective body, did not meet the approval of the Legislature. The proposed act was vigorously opposed by the mayors of several cities of the State, on the ground of taking away home rule rights.

The proposed measure was very drastic, as it must necessarily have been in following the Wisconsin act. It would compel all public utilities, having conduits and poles, to allow other public utilities the use of the same, on the terms and conditions that might be laid down by the commission, and this board would have control of the public utilities to the minutest detail.

Section 10 is indicative of the unjust nature of the proposed legislation. "Sec. 10.—No public utility shall keep any other books, accounts, papers or records of the business transacted, than those prescribed or approved by the commission." It seems past belief that legislation of such character should not be laughed down on its first inception.

The proposed act contained the clauses we have met before, giving the commission absolute power to regulate all rates as well as the service of the public utilities. Municipalities would not be allowed to operate a plant in competition to a public utility without the consent of the commission, or unless the municipality bought out the existing public utility; in the latter event the compensation to be paid for the plant would be determined by the commission.

At the close of the bill, some clauses were tacked on, evidently in an attempt to mollify the municipal officials, who appeared in opposition to the bill. These clauses are absolutely contradictory of other portions of the bill, by giving to the municipality authority to pass ordinances to determine the quality and character of each kind of service rendered by any public utility operating within its limits; and, further, gives the municipality authority to determine what extensions of plant shall be made by the public utilities. It is fortunate, alike for the public utilities and the cause of sane government, that this bill was not passed.

In the State of Indiana, an attempt was made during the last session of the Legislature to enact a public utility bill. I say an attempt was made to carry out such a measure, because the effort came to naught by reason of the pressure of the work that fell to the legislators at the latter part of the session, when the bill was introduced. There is one feature in connection with the framing of this bill that is well worthy of commendation, and I might add worthy of imitation in other States. The bill to which I make reference had its inception in the "Manufacturer's and Shipper's Association of Indiana", and this body in starting out in this work, extended an invitation to each class of utility to have a representative on the committee appointed to formulate the bill. This action shows a proper spirit on the part of those having in charge the inauguration of so important a measure, as the supervision of corporations, which are by some considered private concerns and by others are regarded as quasi-public companies.

The various utilities accepted the invitation, and the following interests were represented on the committee: gas, electric light, water, Bell telephone companies and independent telephone companies. It would be of interest to follow the details of this proposed bill, but space will only permit of noting a few of its salient points.

The bill was drafted to cover all the interests already noted, as well as steam distribution, natural gas and the furnishing of service to public elevators and public warehouses. The bill provides for putting under the supervision of the Railroad Commission of the State the public utilities just noted. The way is provided for such public utility obtaining from the Railroad Commission an "indeterminate permit, which shall not be limited as to time and shall continue in force so long as the grantee shall continue to exercise and enjoy the powers and rights conferred upon and secured to such grantee, and to perform the duties imposed upon such grantee by such grant, provided, however, that such grant shall not affect the powers now vested in municipal authorities, to control and regulate poles, wires, pipes, conduits, with which any public utility occupies the streets of such municipality."

No person or corporation can hereafter begin the construction of any utility plant, without first securing from the commission an "Indeterminate Permit." And before the commission shall grant an indeterminate permit to a party offering to supply a service which is already performed by another company, "The commission must first be satisfied, after a public hearing duly held, that public convenience and necessity require the granting the indeterminate permit for which application is so made."

The commission is empowered to fix standards for the measurement of quality, pressure, initial voltage, or other conditions pertaining to the service of any public utility, and such utilities shall publish a schedule of their rates and tolls, and no change can be made in the same except upon ten days' notice to the commission.

"The commission shall have power to fix and enforce maximum rates for every class of service furnished; in fixing such rates the commission shall take into consideration the necessary cost to the owner or operator of the utility of the product or service furnished, the cost of maintenance, the amount of depreciation in value, including in such amount of depreciation as a part thereof, an amount that will be required for replacement of depreciated parts with new parts after ordinary maintenance and repair shall be ineffective to keep the parts in a state of efficiency, corresponding to the progress of the industry."

"To such costs and amounts shall be added a reasonable return on a sum representing the investment.

"In arriving at the sum representing the investment, the commission shall take into consideration the value of the physical property, all going and intangible values, and all other investments actually and necessarily made."

The bill makes provision for proper hearings on all questions regarding rates and service of public utilities, both on application of the municipalities and the public utilities, and provides for appeal in any such case to the Supreme Court.

A public utility bill was introduced at the last session of the Utah Legislature, but failed of passage. The bill provided for the creation of a public service commission to control railroads and public utilities; most of the bill deals with railroad matters. The purpose of the bill was also to give the commission general supervision of gas and electric companies, empowering it to establish standards of illuminating power and purity, and generally to supervise the service of such corporations. The usual provisions were contained in the bill as to empowering the commission to prescribe uniform methods of keeping accounts and ordering public utilities to make annual reports; these provisions would also apply to municipalities engaged in supplying gas or electricity. Provision was also made for testing gas and electric meters. As the bill did not become a law, it is hardly necessary to refer to it in detail.

From the foregoing it appears that in five States the gas and electric companies have been placed under State supervision; in two States bills bearing upon this subject are pending—and may possibly have been decided before these words appear in print; three States had the subject up for consideration during the last session of their Legislatures and decided not to take decisive action in the matter.

Some 25 States appear to have taken little or no interest in legislation of this character, and there are a few States where my inquiries have not met with a response.

The consideration of this subject has been largely on historical lines and the writer has no intention of adding as an addendum to this article a discussion on the necessity or wisdom of State control of public utilities.

Nor does he intend to enter into an argument at this time of the extent to which such control should be exercised, if such supervision is really necessary, which subjects of themselves would justly form the subject of a lengthy paper, but the writer would offer the following suggestions as subjects for thoughtful consideration.

Managers of public utilities have been very reticent in discussing publicly the subject of State control; to this line of thought the writer would offer the suggestion that the matter of State control of public utilities will be very much discussed in the near future, and it is unwise to allow our socialistic friends to do all the talking; the tendencies of recent movements have been toward giving the commissions *managerial* control of public utilities rather than *supervisory* powers. The writer would suggest to students of civic affairs that our form of government is not adapted to delegating to a small board of commissioners the management of the public utilities of the State; and he would suggest that public utilities should be very slow in passing their properties over to the management of the State authorities. It is not within the limitations of things human, that a small number of men appointed from walks of life which have not brought them into intimate relations with the intricate affairs of public utilities, and without any technical training along those lines, should be competent to manage and direct the details of the public utilities of a large State.

As an example of State supervision along sensible lines we may point to the Massachusetts Gas and Electric Light Commission, where the *supervision* of the companies has been very close, but if the decisions of this Commission covering a period of nearly a quarter of a century have been rightly read, the management of the companies has been left where it rightly belongs, upon the shoulders of the company's officials. The Commission has been strenuous in safeguarding the interests of the public in matters committed to its care, but safeguarding the interests of the public and destroying the prosperity of public utilities have not been synonymous terms.

Let us hope when a quarter of a century hence the history of other public utility commissions is written it will be a story of civic uplift based on the service to the public which has been enlarged and broadened and on the conservation of the rights and property of vested interests.

A Half-Century's History of Gaseous Fuel as Applied to Heating Gas Retorts.

[Prepared by Mr. Fred Bredel, Milwaukee, Wis.]

The first applications of gaseous fuel to retorts were not due to people who were strictly gas engineers, but to mettallurgical engineers in conjunction with gas engineers. The first attempts to use gaseous fuel were made by M. Fabre du Faur, at Wasseralfingen as early as 1837. This did not materialize in perfected shape until 1856. A description of it will follow later.

In 1839 Mr. Bischoff appears to have attempted to build a generator furnace, but there are no records of it available at the present time.

At the blast furnaces of the works of Wasseralfingen, Würtemberg, certain amounts of blast furnace gases were going to waste, and as this iron works had (as most large European iron works at that time) their own gas works for illuminating purposes, the idea came very close to applying these waste gases from the blast

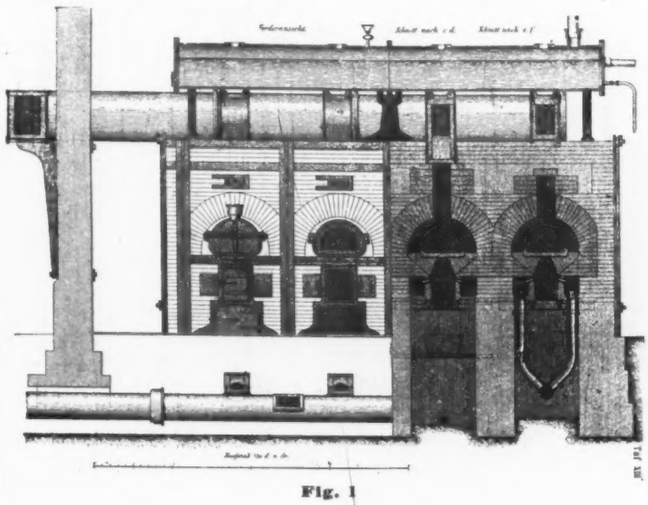


Fig. 1

furnace to the heating of retorts. Figs. 1 and 2 give illustrations of this setting.

Each bench contained one cast-iron D-shaped retort, 23″ by 12″ by 7′ 0″ long, inside measurements. It is worth while to look into the construction.

Ordinarily the bench was heated by blast furnace gases, but when these were not at hand coke was used on the grate. The gases were conducted from the blast furnace through a main pipe and branched off to each bench, of which there were four. From here the gases were distributed to each side of the bench by branch pipes, and passing into a distributing flue and through nozzles, were distributed through the whole length of the bench. Air was admitted through the ashpit door and grate and a partially covered opening in the rear of the bench. The right amount and distribution of the air were obtained by putting more or less ashes on the grate and the partially covered opening. It will thereby be seen that, while the distribution of the heating gases was ideal, the air distribution was somewhat crude, but as that was under such perfect control that the results obtained were all one could ask for, and the retort had an even heat right through.

One finds, therefore, in this installation the principle of regulation of the fuel gases and secondary air, as good as we are using now; gas being admitted through distributing nozzles and air to both front and rear of the bench separate. No attempt was made to either preheat the secondary air or fuel gases.

The first generator bench that the writer knows of is the one built by Mr. Schnuhr, at Berlin, Germany. The only data I have

respecting it is a description by Mr. Liegel, of Stettin. He records as follows: "On a visit to the Berlin gas works, in 1864, I saw a bench of 7's with a small fuel pit in front. The fire was deeper than customary; the grate was inclined 45°; air was admitted through holes in the firedoor above the grate."

As this bench must have been built probably two years or so before we find here our first application of gaseous fuel by means of its own generator; in other words, a true generator bench. Since that time no further attempts seem to have been made to use gaseous fuel for heating retorts, until the theory was taken up by Sir Frederick and Hon. C. H. William Siemens, of regenerative furnace fame, and whose efforts seem the entering wedges for using gaseous fuel in heating retorts. Here, again, we see it was not for gas men but for metallurgical men to show the way.

The first installation, as far as known, was built at the Westminster station of the London (England) Chartered Gas Company, in 1862. Right after (1864) at Vaugirard, a district of Paris, France, and for the same company in 1869 at St. Mandé Station. All these installations were of the well-known Siemens type; that is to say, producer regenerative benches. Not being able to procure a plan of this installation I will give a short description of same:

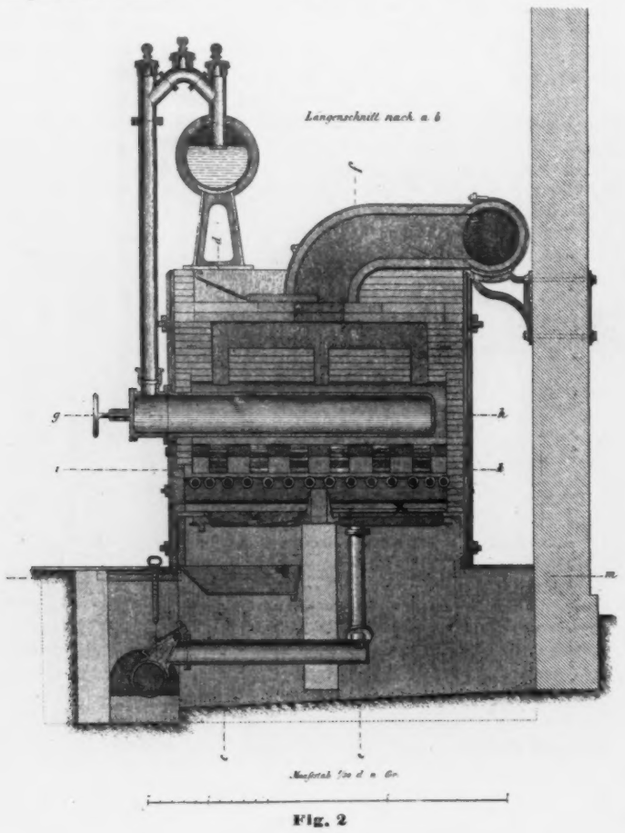


Fig. 2

The producers were of the old Siemens type with open ashpit. The regulation of the amount of gas made by these producers, (at that time called generators) was governed by the quantity of gas consumed, which latter was controlled by valves. These generators were always put up in pairs, either 2 or 4 separate chambers and grates for each nest, the chambers being charged alternately, so when one was burning low the other one would be burning high, thus giving an even composition of gas right along. The necessary draught was obtained by a vertical, wrought-iron flue going up into the horizontal flue, then dipping down by another vertical flue into the distributing flue. The hot gases rising upwards were cooled in the horizontal flue and then into the downward flue by difference in specific gravity. The two sets of regenerators required were placed under the bench, 2 for each set, one for preheating the fuel gases, the other for preheating the secondary air.

These regenerators are of the type of that used to-day in Siemens' open-hearth furnaces; that is to say, rectangular chambers filled with checkerwork brick or about the same way as the superheater in a water gas cupola. Each set being used alternately, the waste gases pass through one set heating the checkerwork while the other set would give its so-stored heat to the fuel gases and the secondary air. This naturally required a reversing of each system of generators at intervals. The installation being finely worked out theoretically should have been very efficient; but it was far from it. Each set of generators would supply about 16 benches. This system was greatly simplified by Ponsard and Lencauchez, who did not reheat the fuel gases, and introduced a recuperator instead of a regenerator. Fig. 3 shows such a recuperator.

In 1866 we find for the first time a generator bench with the generator lying inside of the bench, which was the design of Liegel, of Stralsund. Nothing definite is known of this construction, it having been kept more or less secret, until 1870, when Liegel furnaces were introduced at Frankfort. The first official data were given in 1875. This in its modified form and as used later is illustrated in Figs. 4 and 5.

The generator is of the open-slot type. Instead of a grate there is a slot, the idea being that the primary air will fuse the slack in

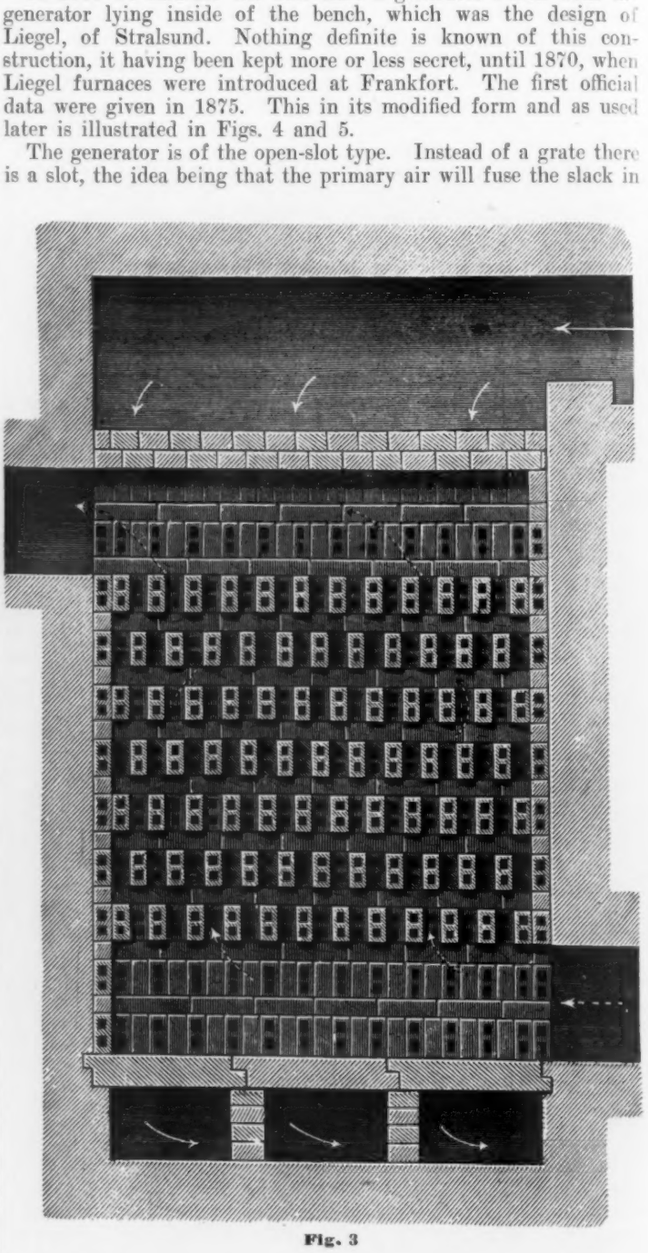


Fig. 3

the coke which slack would run in liquid form through the slot. To prevent the stopping of the slot Liegel used below it a small auxiliary grate to ensure at all times sufficient heat to melt the slack. If the slack was too hard, lime was added to the coke to liquefy the formed slack.

Chronologically we come to the ovens of Mueller and Eichelbrenner, at Montreuil, France, illustrated by Figs. 6, 7 and 8. This installation dates back also from the early '70s. Mueller was a Keramic engineer, Eichelbrenner was the gas man. Here the first attempt is made to preheat the secondary air. The secondary air flues being right below the waste gas flue beneath the lower retort, a tile separating waste gas and air flues. It can scarcely be called a recuperator, but it showed the beginning of one. The generator is of the separate type lying in the rear of two benches. The benches of Conrad Voss & Oechelhauser did not differ essentially from the Messrs. Mueller & Eichelbrenner.

Hagener, at Cologne, was the first to use a deep generator, and

be made an attempt at recuperation by means of horizontal flues. However, nothing definite can be found out at this date regarding the details of his generator.

We come now to the Kloenne bench, of 1876. Here the first time we find something different. The generator lies inside of the bench, and is closed and provided with nostrils for facilitating the distribution of heat. There is no grate, and the slack had to be removed from time to time. Not much attempt is made at recuperation. See Figs. 9 and 10. Mention is also made here of the bench of Grahn, who preheats the secondary air above the skeleton arch, but this is done by radiated heat given off by the rear wall and the arch and, therefore, no recuperation at all.

Of detached generators besides the aforesaid, we find the bench of Hasse, Fig. 11. Here we find for the first time an attempt to fire hot coke. These were installed at Dresden and one generator would generally supply two benches.

Probably the first American gas fired bench was the Dieterich furnace, patented in 1878. See Fig. 12. The first installation

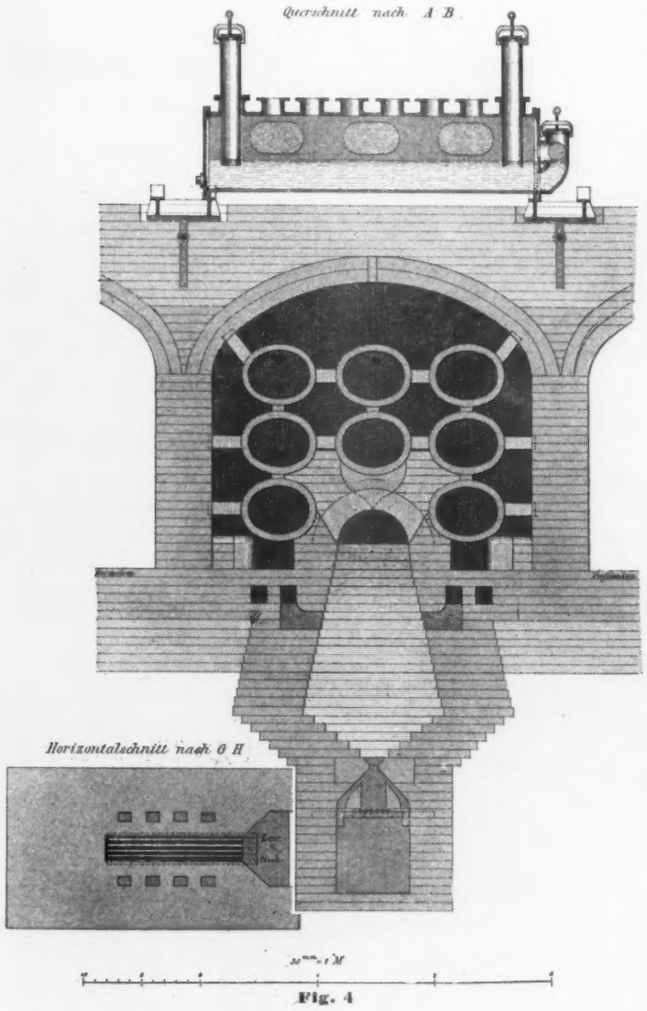


Fig. 4

of these was made at Scott Street station, Baltimore, Md., and in 1880 at Providence, R. I. This is practically a detached generator furnace with no attempt at recuperation.

The benches of Mr. J. Livesey, Mr. F. Livesey and Messrs. F. and J. Sommerville, probably the first English introduction, are more or less an adaptation of Liegel, no attempt being made at recuperation.

From now on the different gas engineers seemed to have become alive to the necessity of recuperation. At first we have only horizontal flue recuperators. Of these designs are the Munich, the Kloenne, the modified Liegel, the Hasse and the Stedman. The latter was patented in the United States in 1880, by the late Col. W. A. Stedman. Here we find also the first attempt to equally distribute the heat in front and rear of the bench. Kloenne obtains this by putting one more parallel air flue on one side of the bench than on the other; the generator having only one row of gas nostrils, while there are two rows of air nostrils, one on each side of the generator nostrils. It follows, as the air enters one distributing flue from the front and the other from the rear, that more or less air can be given to either side.

The benches of Stedman are illustrated by Figs. 13 and 14; the N. H. Schilling and H. Bunte, in Figs. 15 and 16, and the recuperator of the Kloenne furnace (1882) by Figs. 17 and 18.

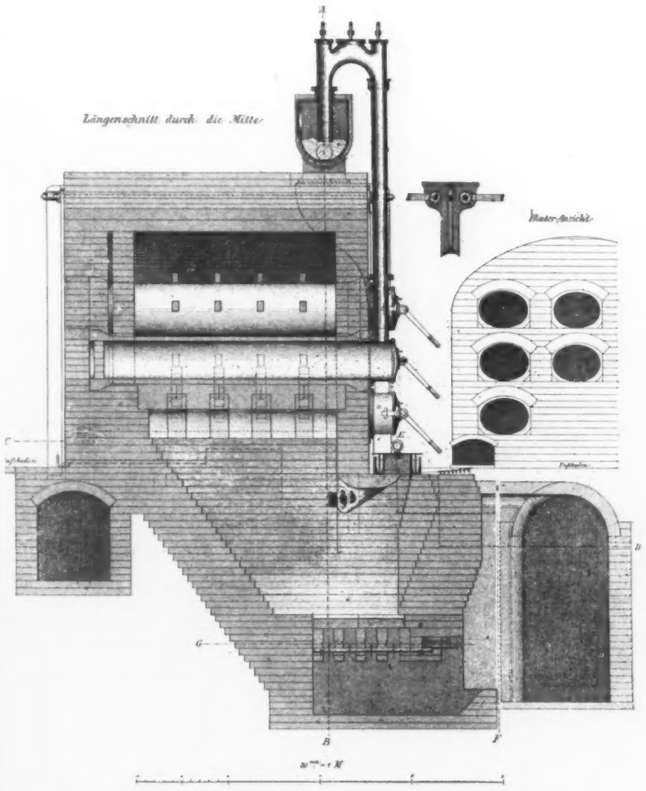


Fig. 5

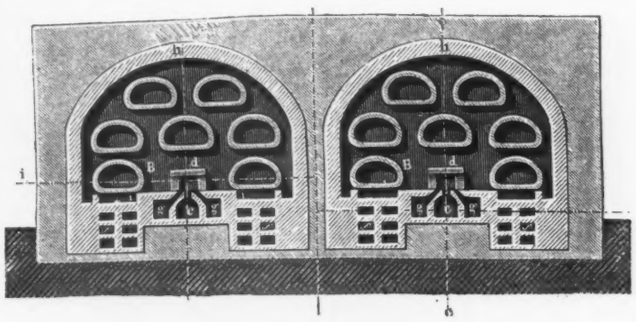


Fig. 6

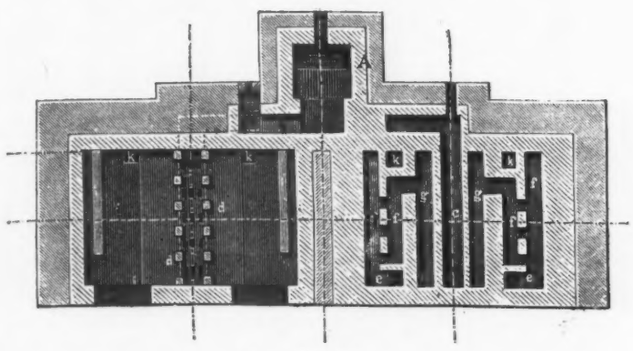


Fig. 7

We have here three different types: The detached generator of Schilling & Bunte; the open inside generator of Stedman; and the closed inside generator, with cross recuperator, of Kloenne. All three systems are recuperative benches in the fullest meaning, and not only preheat the secondary air but also the primary air. The first two have horizontal flues, while the Kloenne has the cross

recuperator and therefore practically only one gas flue. The first two mentioned not only preheat the primary air but also evaporate water by means of the waste gases, whereas Kloenne depends upon the higher preheated secondary air striking over the water in the ashpan and by dripping water over the step grate to obtain a sufficient amount of moisture under the grate. To obtain sufficient heating surface for the secondary air, which was up to now certainly lacking, Dr. Schilling & Bunte detached the generator and used the entire space under the bench for recuperation, while Kloenne obtains this through his cross recuperator occupying less space. It seems the latter two have struck one of the right principles by giving sufficient area to the recuperator.

I want to also mention the bench of Hasse and Didier which is practically an adaptation of the Schilling, the main difference be-

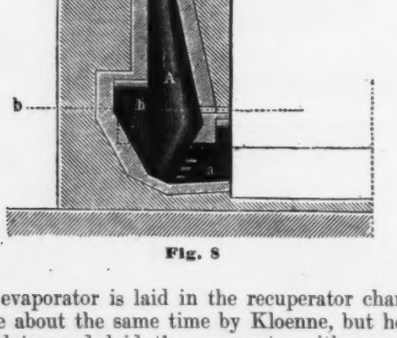


Fig. 8

ing that the evaporator is laid in the recuperator chamber. This was also done about the same time by Kloenne, but he abandoned the position later and laid the evaporator either on top of the bench or in separate flues. In England the recuperative benches were taken up, quite successfully, by Mr. Hunt, of Birmingham, Mr. Carpenter, and Mr. Foulis, of whom I will speak later.

In this country they were taken up early, after the trials of Dietrich and Stedman, in conjunction with Stanley by Mr. George A. McIlhenny, of Washington, D. C., and Mr. G. Arndt, of Chicago, who adapted the Hunt recuperator.

Of foreign style benches that were introduced in the United States we must mention the Schilling-Bunte (Munich) and the Kloenne.

Stedman-Stanley must have been built in the early eighties. [Newport, R. I., Sept. 1879.—Ed.] The McIlhenny was introduced prior to 1882 in Washington. In Cincinnati the first benches with gaseous fuel, which were simple generator benches, were built in 1881; while the first recuperative benches were built in the same place in 1882, on the McIlhenny system.

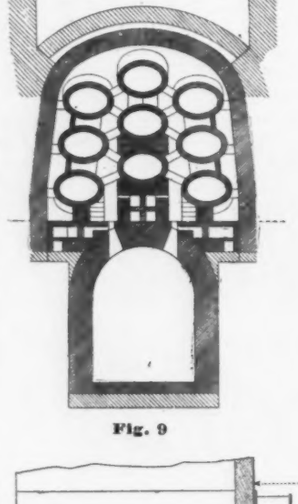


Fig. 9

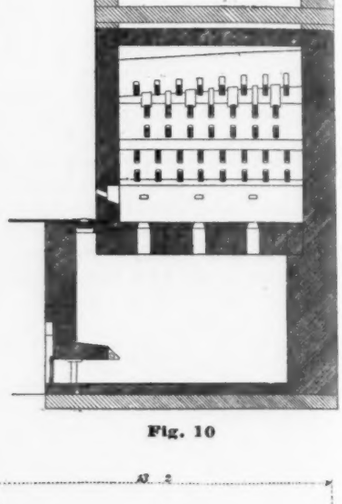


Fig. 10

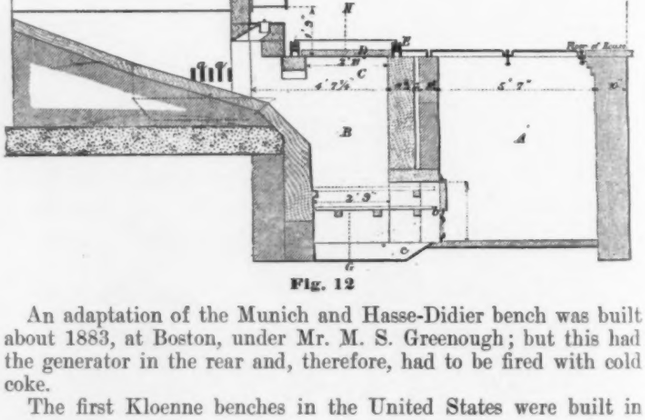


Fig. 12

An adaptation of the Munich and Hasse-Didier bench was built about 1883, at Boston, under Mr. M. S. Greenough; but this had the generator in the rear and, therefore, had to be fired with cold coke.

The first Kloenne benches in the United States were built in

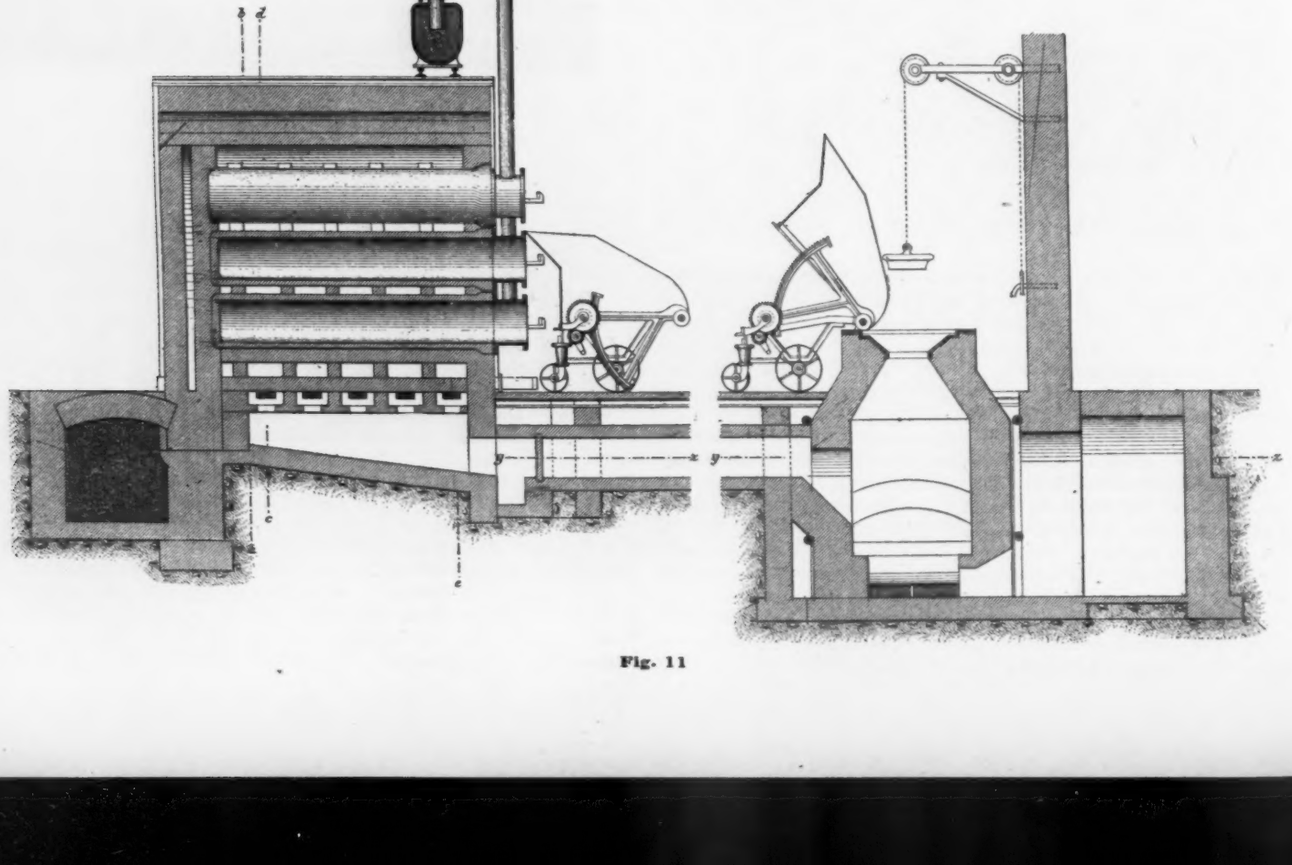


Fig. 11

1884, at Newark, N. J., by Mr. Eugene Vanderpool and the writer, and in 1885, at Chicago, at which place also the first Arndt installation was put in. We have here also to mention the recuperative furnace of W. J. Jones, of Rome, Italy; but this never got beyond Italian practice, in fact never beyond Rome as far as known.

In France, at that time, there seems to have been a standstill. Most benches built were of foreign design and only very few of them, which was, on account of the suit of the City of Paris against the Paris Gas Company, to amend the terms of the latter's lease.

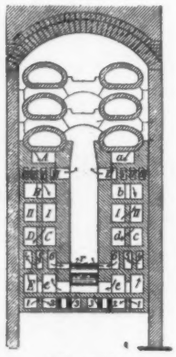


Fig. 13

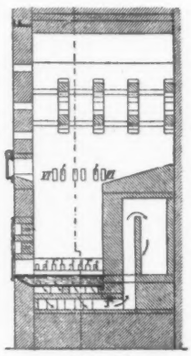


Fig. 14

In England and Germany, in addition to the original designers before mentioned, competent engineers took the work in hand, and it became a question who could build the best recuperative bench. In this country, with few exceptions, it became a period of retrogression. It became a question not of who could build the best recuperative furnace, but who could build the cheapest. This kept up until the latter part of the '90s, when some progress was

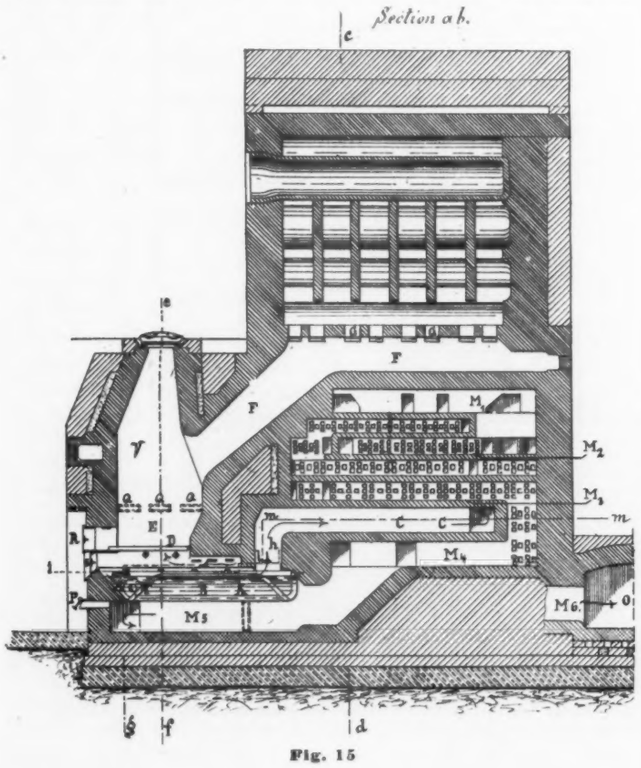


Fig. 15

again made. Step by step it became known that heating surface alone in a recuperator was not all that was required, so the recuperators were built larger and heavier. Larger to give more time for the waste gases to give up their heat and reduce friction; and heavier to act as accumulators.

In the mean time Kloenne had abandoned his cross recuperator, on account of its liability to leak, and the great difficulty over patching it, while in this country Bredel improved it so that it became a much more substantial recuperator. He had, however, to abandon it later on account of the difficulty in cleaning. Of the American designers we find Mr. K. M. Mitchell, illustrated in Fig. 19, of the so-called organ pipe (vertical type) design. He reheats only the secondary air.

Another American, Oscar B. Weber, of New York, illustrated in Fig. 20, introduced his bench in 1888. This style of recuperator is somewhat of a new departure from the common horizontal flue system—an air-flue lying between two gas-flues, but there are two

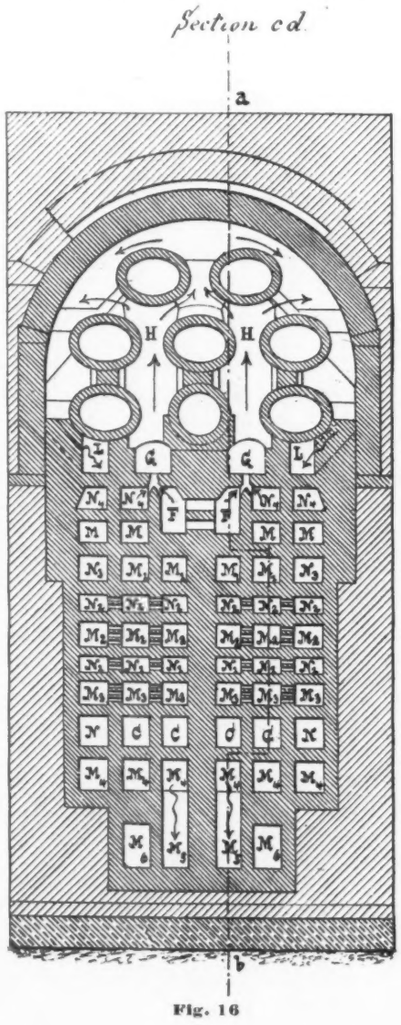


Fig. 16

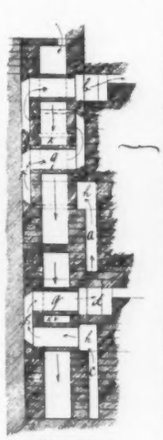


Fig. 17

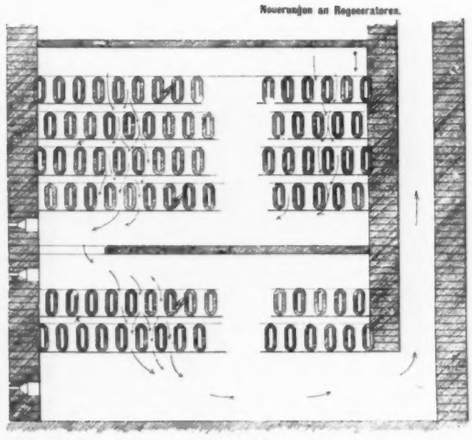


Fig. 18

gas-flues between each two air-flues. This prevents the crossing of either gas or air-flue in front of the bench. It can be easily gotten at and there is very little chance for leakage, but the efficiency seems rather low. This is a recuperator bench in its fullest meaning, as it preheats primary and secondary air. Regarding the generator he has come back to the open style. I would also mention the construction of the Parker-Russell design whose recuperator was first the ordinary horizontal flue design but was

changed later into a combination of horizontal and vertical flues. Parker-Russell turns the air around 90° and lets it travel crossways to the length of the retorts. He obtains, thereby, a recuperator with horizontal parallel gas flues which are crossed by the air flues at right angles; a part feature of the horizontal flues and part feature of the Kloenne recuperator.

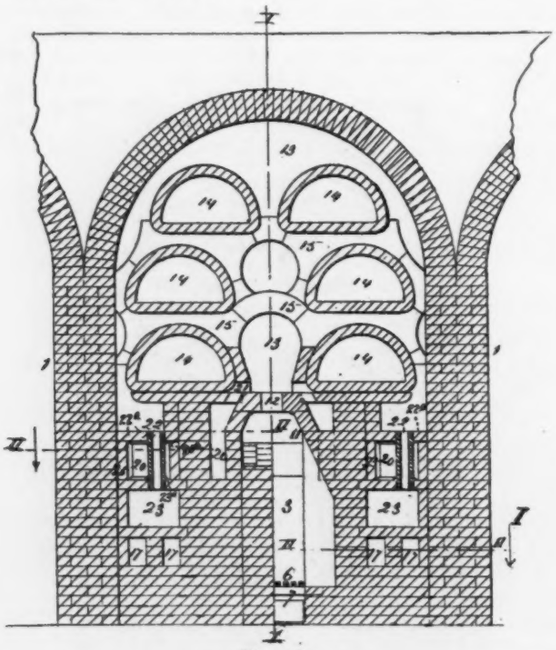


Fig. 19

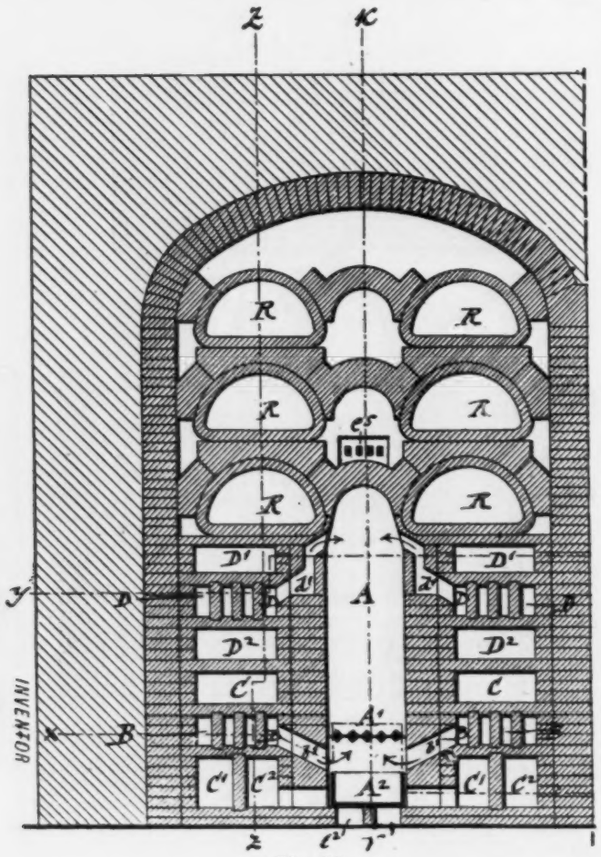
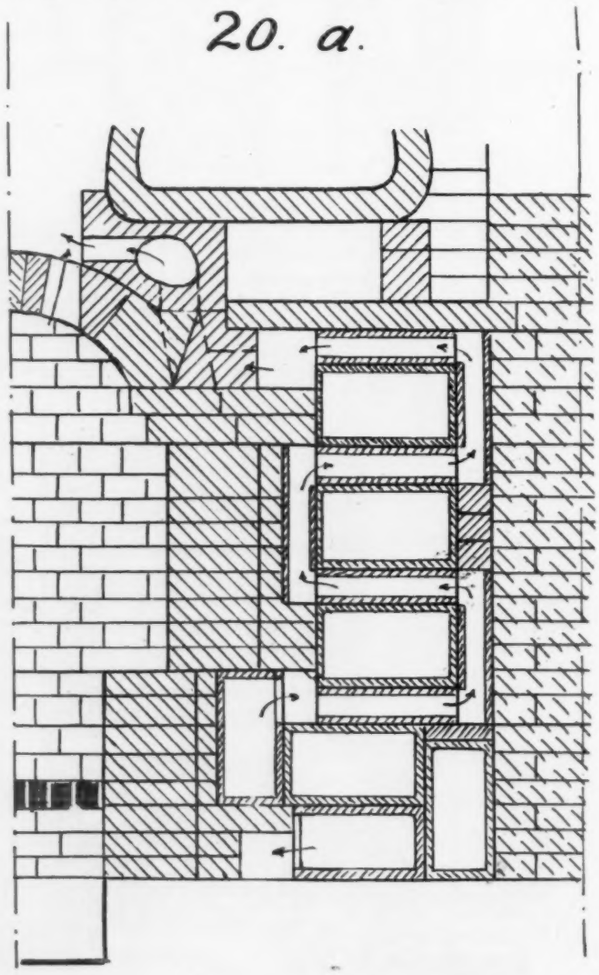


Fig. 20

None of the American designs, with the single exception of the Weber, evaporated any water by waste gases. This was only a paper design and was abandoned in actual execution and live steam used. The only benches built in the United States that evaporated water by the waste gases were the Munich and the Kloenne, as later adapted by Bredel. The reason for not using the evaporator was the high quality of the American coal which contained comparatively little ash. In 1886 we find an entirely new departure in recuperators, of which Mr. Kloenne was the originator. The first installation of this kind was executed at Kaiserslautern, Germany, in 1887 and is a strictly parallel flue recuperator. He has here abandoned the idea of laying an air-flue under a gas-flue, or vice versa, and gas and air-flues never cross themselves. All gas and air-flues are accessible from the front of the bench. Fig. 21a shows this arrangement. Every flue and every joint become here accessible to inspection and patching, which never was accomplished before where horizontal or vertical, or combination horizontal-vertical or zig-zag, or cross-flues were employed. The design of recuperator was hereby very much simplified and became much more efficient in that the drawing back-and-forth of the waste gases was done with the least possible friction.

Drs. Schilling and Bunte seem the first to see the importance of getting a thorough mixture of superheated water vapor and preheated primary air. They also had the great advantage of laying



the generator in front of the bench, so it naturally followed that the gases from the generator were taken off at a constant height and no air could enter the furnace while filling the generator. Kloenne accomplished this by taking off the gases from the sides of the generator below the nominal fuel height. Fig. 21 shows the parallel flue arrangement, now generally adopted in Europe, in which two gas-flues in the same horizontal plane are flanked by two air-flues. All the improvements made from here on were mostly improvements in the setting, the shape of the generator and the style of the recuperator having been established by each designer.

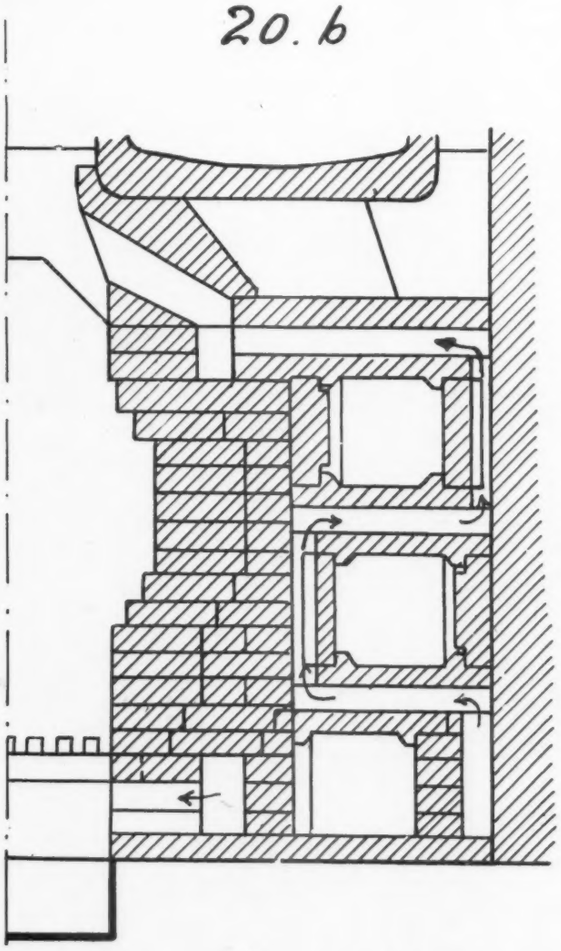
So far all the benches fired by gaseous fuel, with the exception of the first Siemens installation and its adaptations, used a generator for each bench, with the exception of the Mueller-Eichelbrenner, and such systems where there were two benches to a generator, but benches fired with producer gas had been abandoned.

The first re-introduction of outside producers was installed for the Erie (Pa.) Gas Company, by Mr. Bredel, in 1894. Figs. 22 and 23 show this producer-fired bench, and Figs. 24 and 25 show the producer. This producer is a modified Siemens, or more correctly a modified Siemens generator. The twin generator principle

is retained so that all the time when one is low the other one will be high. The gas is collected in a main flue and then brought by means of a 24-inch pipe in front of each bench, of which there were six, and distributed by means of a valve. The bench has a good cross-flue recuperator, but as regards reheating the producer-gas very little was done, the only thing being the reheating through one horizontal flue. It was thought to fire this producer with coal, but, on account of the absence of necessary condensing capacity, it was proven cheaper to use coke, and these benches did very good work.

Next it was taken up by Mr. William Foulis, of Glasgow, and also by the South Metropolitan Gas Works. In '99 Mr. Foulis wrote to the writer of this article, as follows: "In reply to your favor of the 23d inst. All our ovens here are heated with outside producers, one to each oven. I have had the idea of heating a number of ovens from one producer for a long time. In 1896, in an address to the Institution of Gas Engineers, in referring to the use of regenerative furnaces I remarked as follows: 'A further development and improvement of this system will, I think, be found in having producers of large size, altogether

20. b



separate from the retort benches; the gas being led in properly constructed flues to the various retort ovens, and possibly also to other parts of the works where heating or power is required. These producers might be supplied with forced draught, and so arranged that one or more of them would always be in the condition of maximum efficiency.' The only movement I know of which has since been made in this direction are some experiments at the South Metropolitan Gas Works, London. I do not know with what success. I had no opportunity until about six months ago of putting the idea into practical use.

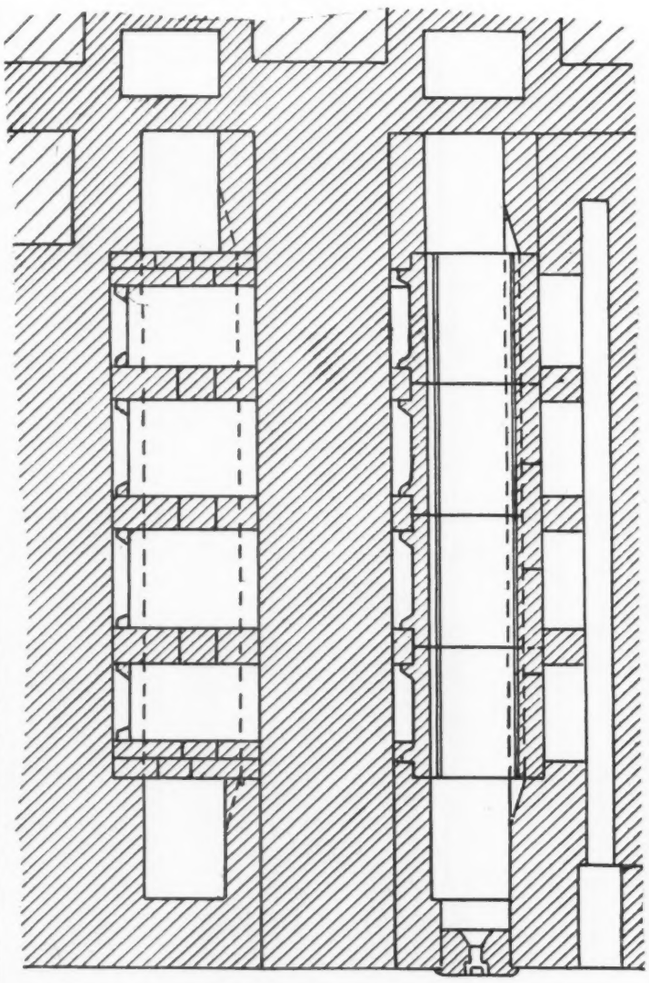
"Three producers were then erected outside one of the retort houses at our Dawsholm works. These communicate by means of flues with a bench containing 16 ovens, of 12 retorts each, or 192 retorts in all. They have been at work all the winter with very promising results. One or two alterations of detail will require to be made to meet the difficulty of dealing with our coke which, containing from 15 to 20 per cent. of ash, is difficult to deal with in any producer."

In the Foulis bench setting the secondary air is preheated in a parallel flue recuperator as well as the gases which are regenerated by a parallel flue recuperator, all by means of the waste gases, but differs from the Bredel in so far as a regular iron-clad round producer is used. Similar installations are also made by Drake. The producer in these installations became necessary, on account of the large amount of ash contained in the coke, as it was practically impossible to keep the generator clean. As will be seen the twin producer system has been retained.

The producer system has also been introduced by Messrs. Parker-Russell in this country for the heating of inclined benches, but here the twin producer system has not been retained, only a single producer is used.

The improvements made in the setting, since the first installations of recuperative benches were mostly in detail of design and mostly in benches of nine or more retorts, where the central retorts are on top of the generator arch. Some of the more prominent

20. c.



ones are partially supporting the center retorts by the side wall of the generator, as shown by Fig. 26, and the cooling of the supporting blocks by means of the secondary air, and the free development of the flame by letting the gas go any-which-way in the bench it pleases, instead of forcing it first to the top of the arch and then drawing it down. This particular way of setting has made benches of 9s, 12s and 15s possible.

From now on we have no developments, until we come to the retort setting of Mr. S. B. Russell, (1905) and Mr. F. Bredel, of the same year. The design for both settings is for retorts about 20 feet long. It had been found difficult to heat the through setting with a generator on one side only and, therefore, double generators, one on each side, had been used. This naturally prevented the use of such machines charging or drawing as the De Brouwer or Fiddes-Aldridge, which pushed the coke out on one end, for it would have been necessary to bring the coke around to the other side, firing one side with cold coke. To overcome this difficulty Mr. Russell lays the two generators on the discharging side of the

bench, side-by-side, and uses the other side for the recuperator. He uses one generator to heat the charging side of the bench, the other on the discharging side. Figs. 27 and 28 illustrate the principle.

In his bench Bredel lays the generators also on the discharging and the recuperators on the charging side, but connects both generators so that the gases evolved will mingle together. The gen-

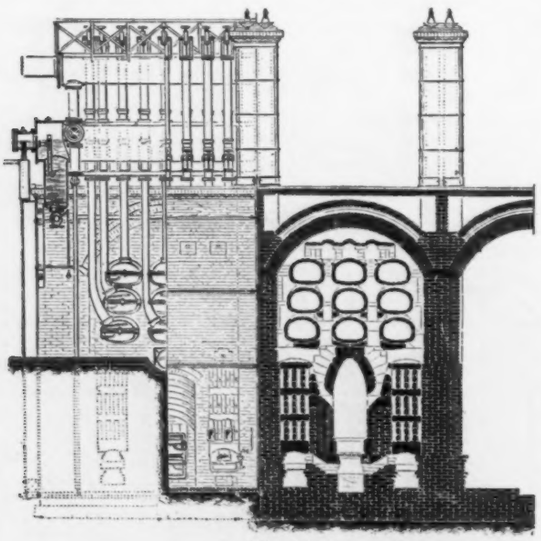


Fig. 21

erators are filled, cleaned, and clinkered alternately, so as to have a clean generator working always with a more or less dirty generator so that the mixed gas be constantly of the same even quality. Figs. 29 and 30 illustrate the design.

An entirely new departure in recuperators is shown in Figs. 31, 32, 33 and 34. These are the first chamber recuperators ever designed. They closely follow the system of parallel flues as regard to heating the air, both primary and secondary; but there are no waste gas flues. Instead of that a chamber running the

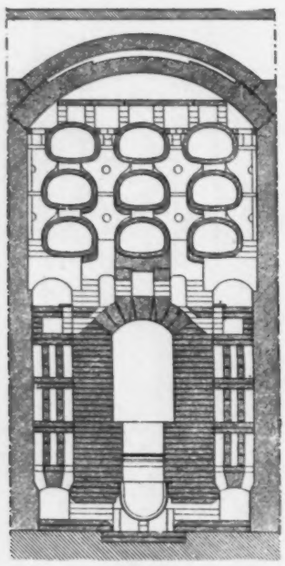


Fig. 21a

entire length and depth of the recuperator is adapted, the waste gases entering the chimney flue with practically no obstructions. The solid cross-pieces used are put in, for strengthening purposes in the horizontal plane, only to prevent the recuperator from being instable, and to take up the side pressure of the generator. The air travels either unobstructed from the bottom straight up to the top or is drawn back-and-forth, and it can be divided up in as many currents as needed. For standard lengths generally two separate secondary air flues are used, one front and one rear; for longer benches, three or more. The claim for this recuperator is that it diminished the draught required, as there is practically no friction for the waste gases, and also that there is no chance for the recuperator being blocked up through negligence of not cleaning on the part of the operator, and that very joint is accessible from the front of the bench.

Mr. Henry L. Doherty took up the reintroduction of carbonic acid gases under the grate, which had been tried by Siemens, and Head & Pouff, for reverberatory furnaces for metallurgical purposes. While Siemens used a steam-jet injector to reintroduce the

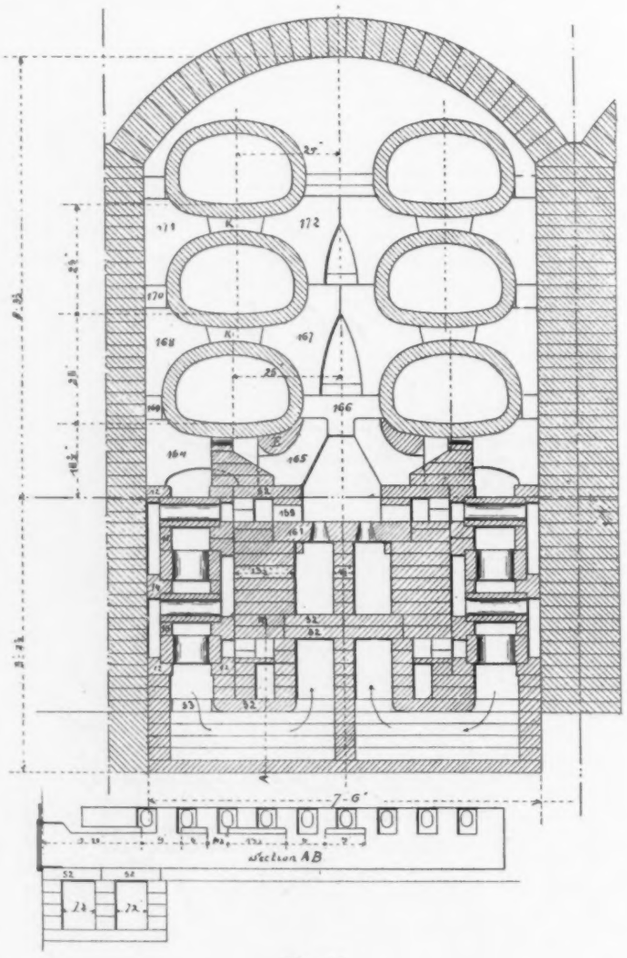


Fig. 22

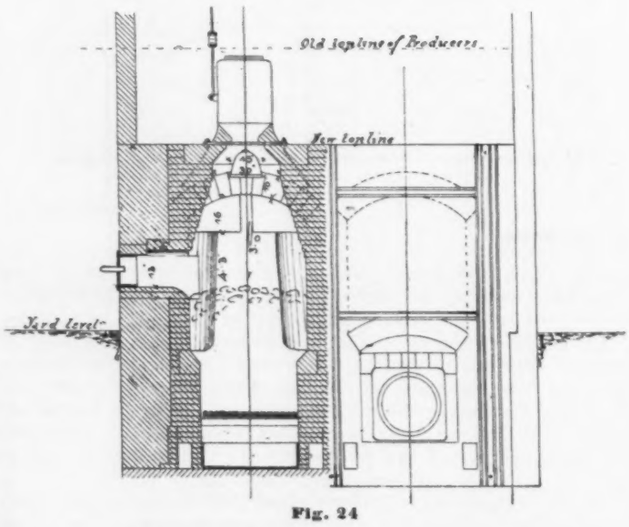


Fig. 24

carbonic acid gases under the grate, Mr. Doherty uses compressed air and, therefore, runs a practically dry generator. It is claimed for this invention that it will prevent clinkers.

As far as the use of gaseous firing for inclines is concerned, they have all been on the generator-recuperator system, and every kind of recuperator known practically has been adapted, as it would be

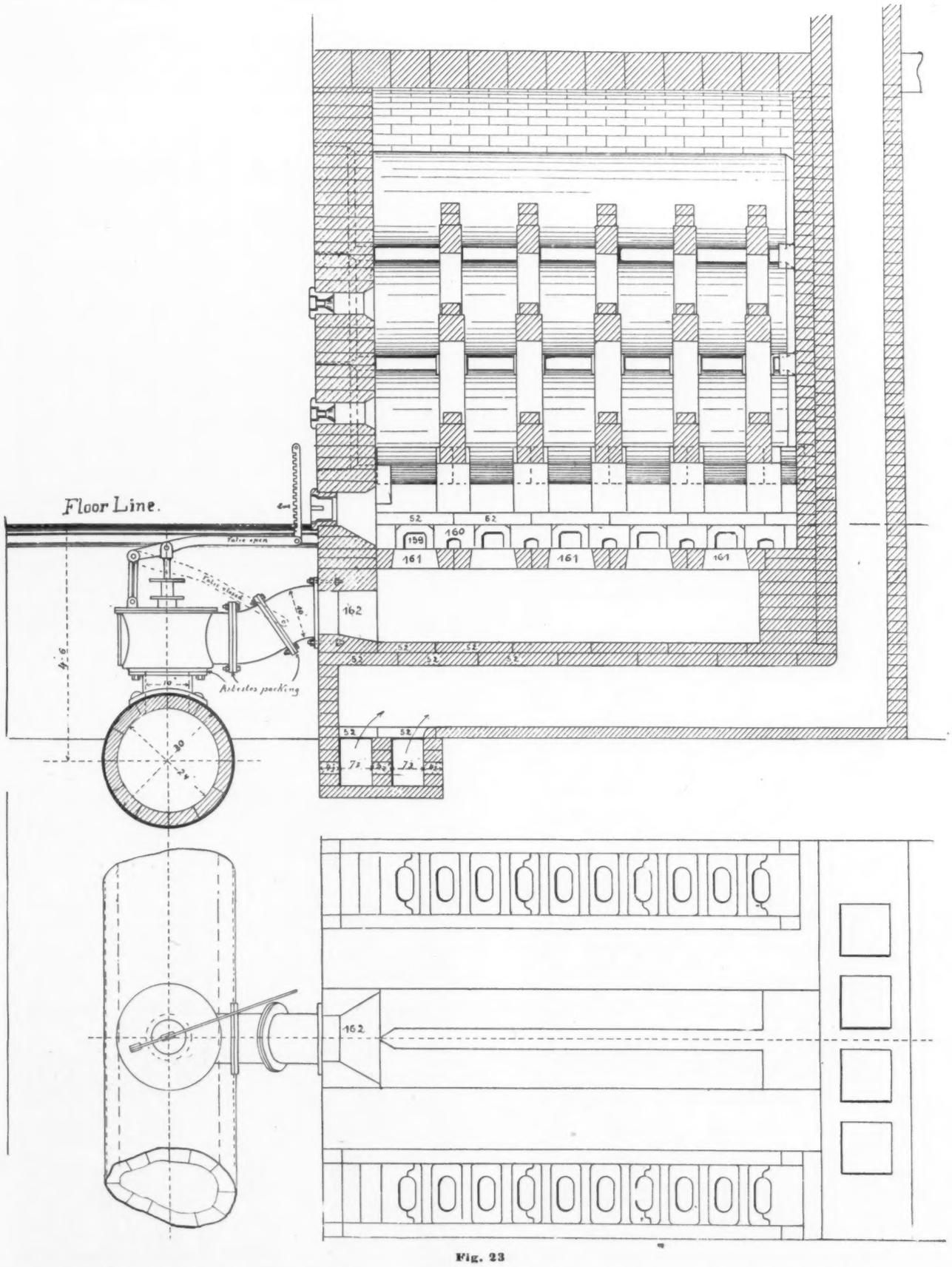


Fig. 23

almost impossible to do otherwise. Didier-Stettin went so far in enlarging the recuperator for inclines that they are of such dimensions that a man can crawl into and patch them up.

Regarding the settings, the ordinary one is used in most cases, save in the cases of Hunt, of Birmingham, and Bredel, of Milwaukee, who give a flat-bearing surface of the retort for every pier. This is done by molding a ring around the retort shown in Fig. 35. This system is also now used by Mr. George R. Love, Fig. 36, where this support becomes practically necessary on account of the incline of 45° instead of the commonly used 32°.

Another system of setting has been introduced by the Stettin firebrick people in which the top and sides of the retorts is free

of the settings so that they can expand and contract. They claim to prevent breakage of retorts by expansion and contraction.

The different systems of vertical retorts have all been heated by a generator lying on the outside of the setting proper, the generator being flanked on both sides by parallel flue recuperator. The

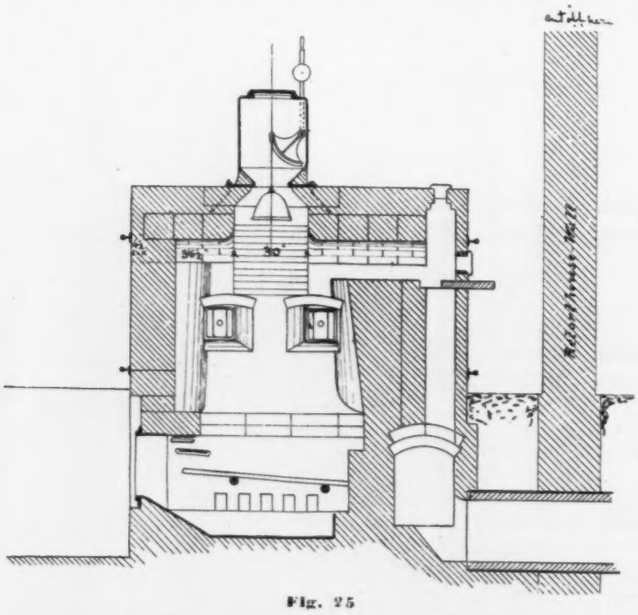


Fig. 25

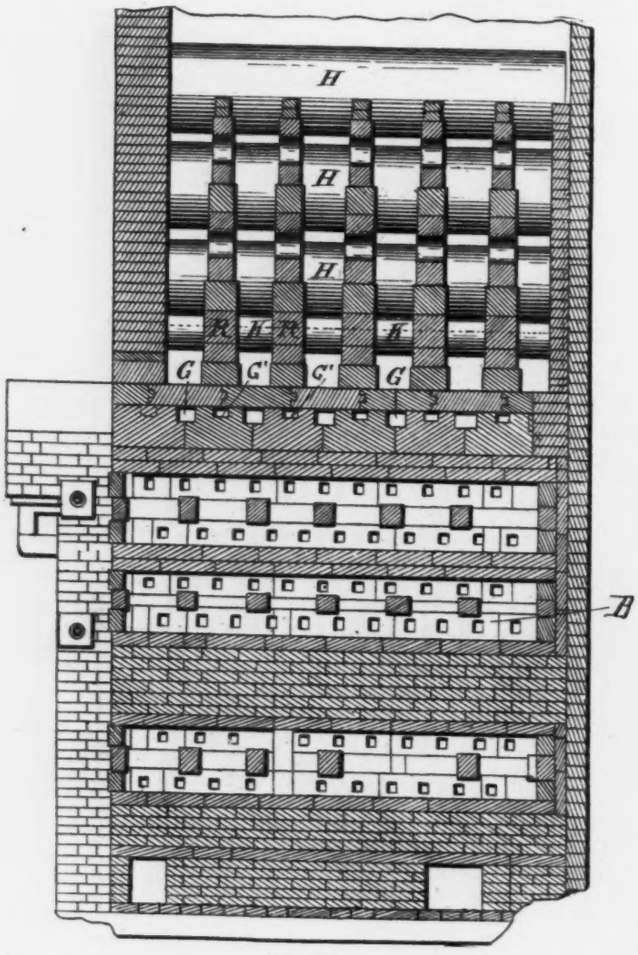


Fig. 26.

construction of vertical retorts makes this design practically a necessity and, considering the first high cost of this kind of installation, it would be suicidal to use anything but the very best design of generator and recuperator. In the first installation probably not enough attention was paid to the uneven expansion of the

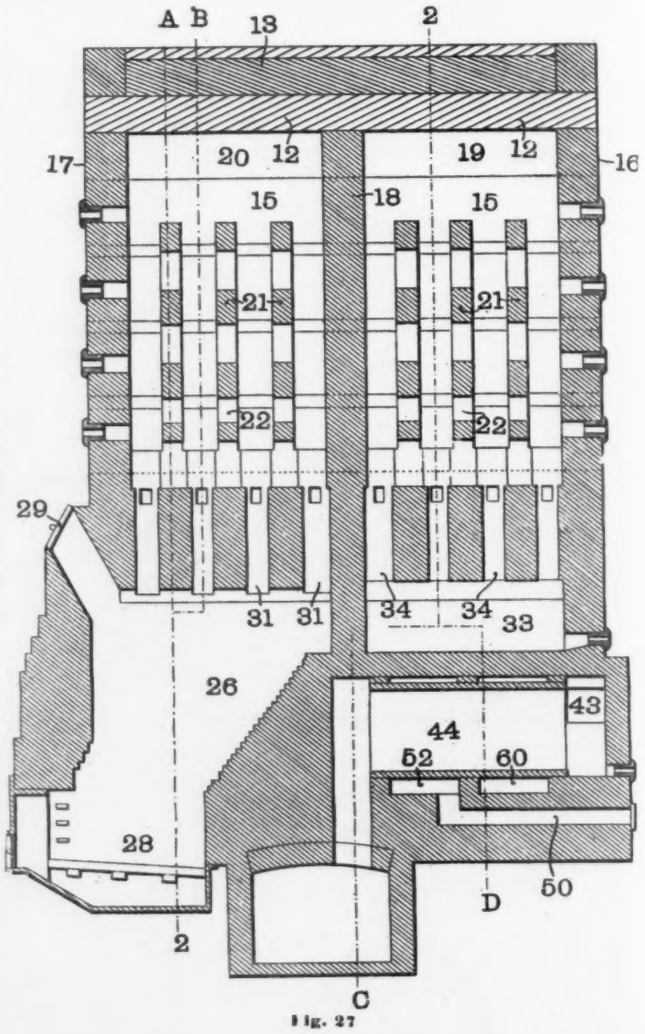


Fig. 27

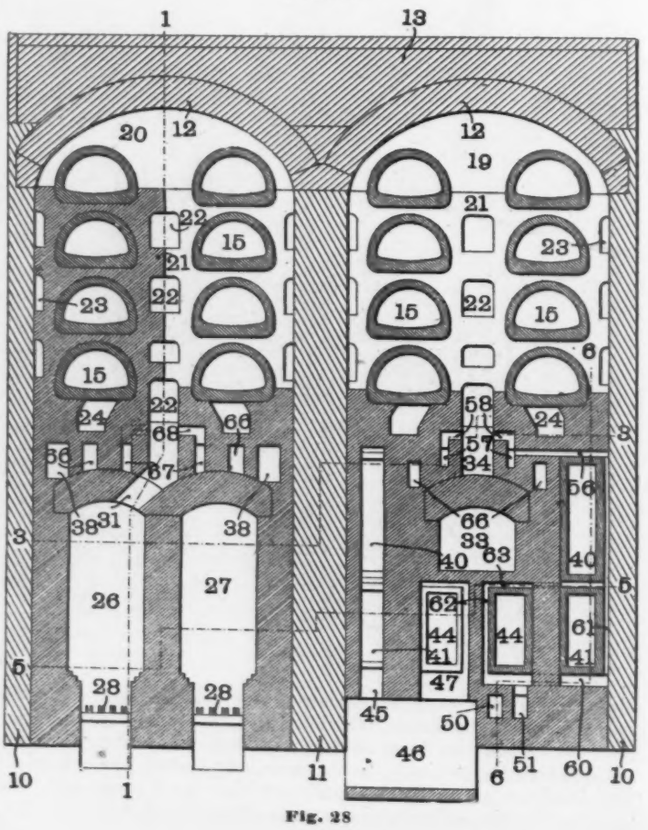


Fig. 28

generator and recuperator, but this is gradually being overcome.

All chamber ovens are fired with outside generators containing from three to four chambers for horizontals and inclines, and five chambers for verticals. The horizontals and inclines are charged every 24 hours, while the verticals take 12 hour charges. The chambers in the horizontals are from 13 to 20 feet long, and take

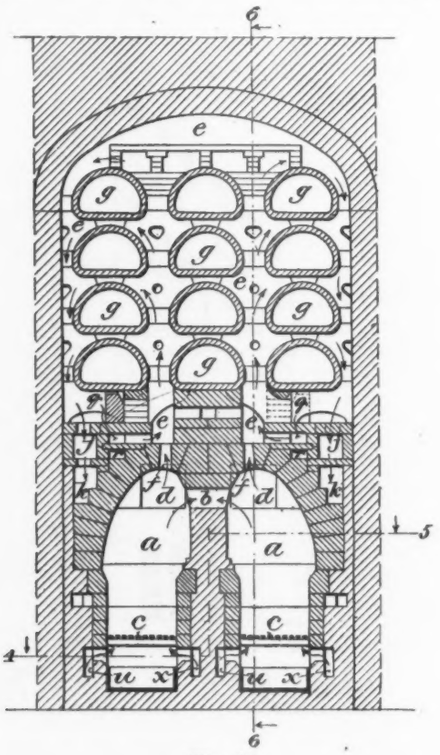


Fig. 29

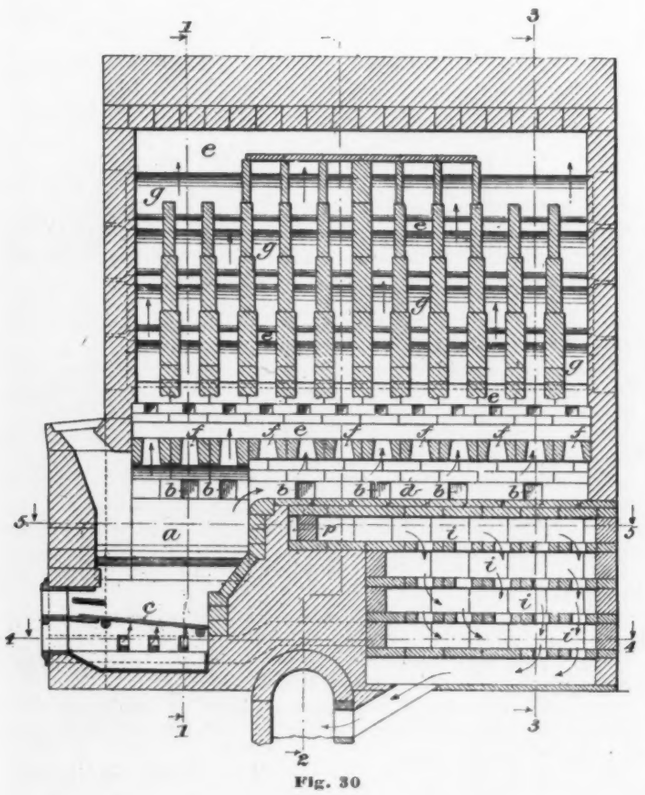


Fig. 30

a charge of from 3 to 4½ tons per chamber, or virtually from 12 to 18 tons per 24 hours per oven. The verticals take a charge of about 2,900 pounds per chamber per 12 hours, which makes, per oven of five chambers, a charge of 29,000 pounds per diem.

The inclines, 30 feet long, take from eight to nine tons per chamber per 24 hours, or a 4-chamber oven from 32 to 36 tons.

As regards to the efficiency of recuperative furnaces the least fuel consumption would naturally be used in a bench having its own generator, laid as close to the bench; better yet, in the bench, as can be done. The generator should be of such design that it has a large grate area, yet not larger than necessary, for with too large an area too much coke is wasted in pulling out ashes, etc. The minimum of water vapor should be used under grate.

The question if open or closed generator should be used depends on whether there are two or three tiers of retorts. With two tiers, each tier consisting of three, four or five retorts, respectively, benches of 6s, 8s, or 10s, the writer favors the open generator, providing arrangements are made to distribute the secondary air cor-

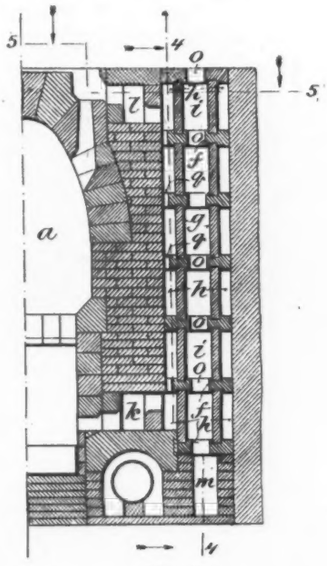


Fig. 31

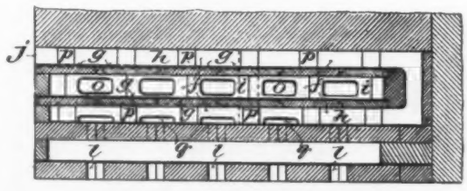


Fig. 32

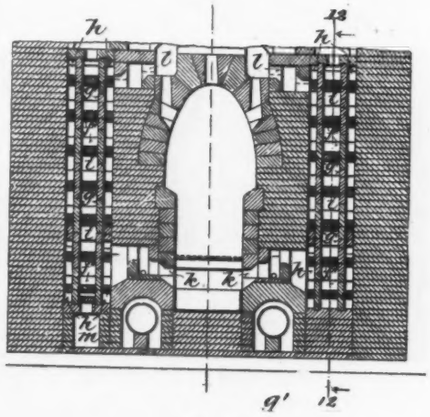


Fig. 33

rectly, so that the bench will be under complete control at any point where combustion takes place. In benches of three tiers of retorts, that is to say, benches of 9s, 12s or 15s, the open generator can scarcely be used excepting where coal is fired instead of coke.

The recuperator should be bulky to act as accumulator and should have plenty of heating surface so as to preheat the air as high as possible. It should have plenty of volume, especially in gas flue, to give the gas a chance to give up its heat; and for the same reason air-flues should be large enough.

In the combustion chamber, and from there to the inlet of recuperator, the flame should be left to itself to freely develop and not drawn back or forth, or forced. The gases, while in the recuperator, should traverse the recuperator without the least possi-

ble friction as friction means loss of energy and larger draught. This, again, means waste of fuel, as part of the heat is transformed into mechanical work, further, larger draught means irregularity in the heat. This will explain why sometimes benches with a less simple recuperator and less heating surface will do better work than very elaborate recuperators, the latter wasting too much heat by transforming it into mechanical power.

The question if producer-gas or generator should be used is one of local consideration. Where coke has a good market at a good price the single generator is preferable to producer, as it consumes less fuel. When employing producer all the latent heat after leaving the producer until entering the bench is lost. The recuperation will only partly recover that, and recover it only at a cost of colder secondary air; while again, the wear-and-tear on the retorts is less with a producer and the control of the benches is easier. Where coke is cheap, like, for instance, in Glasgow, where a ton of

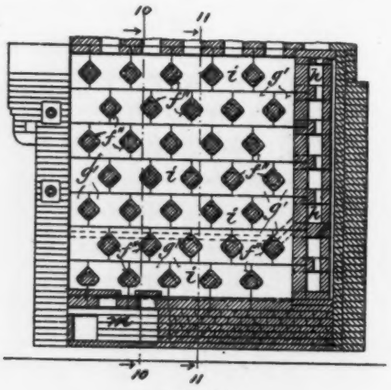


Fig. 34

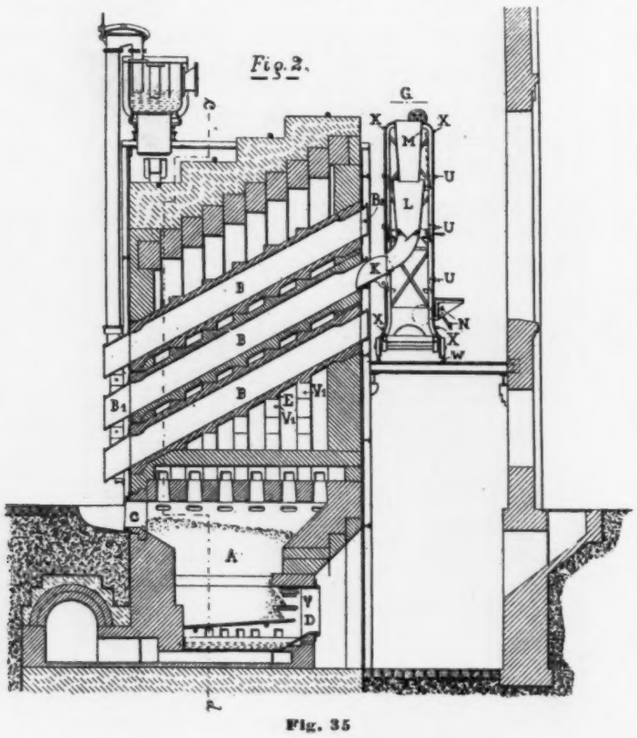


Fig. 35

coke sells for less than a ton of coal, and is very much a drug on the market, the advantages obtained by a producer might counterbalance the loss in coke.

What we have to be thankful for to recuperative furnaces is:

First—Saving in fuel.

Second—A saving in labor on account of higher heats.

Third—Tremendous decrease in retort house area required to make 1,000 feet of gas.

Fourth—Fires easier to be handled and by lesser amount of skilled labor.

Fifth—The possibility of designing benches with retorts four and five tiers high.

Sixth—The possibility of using three tier benches with 9, 12 and 15 retorts.

Without the use of generator-recuperator furnaces all this would have been impossible. When it comes to verticals, inclines and chamber ovens they could not be fired by free-fire furnaces and without the generator-recuperator system or producer-recuperator system, this style of gas manufacture would have been impossible.

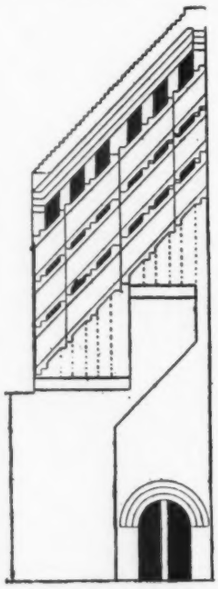


Fig. 36

CHRONOLOGICAL TABLE.

1856. First gas-heated retorts, 1856; Mr. Fabre du Faur, at Wasseralfingen, Germany.

1864. First generator with inclined grate, prior to 1864; Schnuhr, at Berlin, Germany.

1866. First inside generator with slot and without grate, 1866; Liegel, at Stralsund.

1869. First outside generator and first attempt at recuperator; Mueller & Eichelbrenner, at Montreuil (probably in 1869).

1872? First deep generator and horizontal flue-recuperator; probably Hagener, at Cologne.

1876. First closed generator; Kloenne, 1876, at Bochum.

1877? First attempt to use hot coke; probably Hasse, date unknown, at Dresden.

1878-79. First American generator bench, no recuperation, using hot coke; 1878 or 1879, at Scott Street Station, Baltimore. Dieterich.

1879. First attempt to regulate secondary air supply for front and rear of benches; Kloenne, 1879. Probably first executed at Union Steel Works, Dortmund, Germany.

1880. First English adaptation, Mr. J. and Mr. F. Livesey, and Mr. J. Somerville, 1880; Old Kent Road Station, South Metropolitan Gas Works, London, England. Adaptation of Liegel.

1881. First preheating of primary air; N. H. Schilling and H. Bunte, also, Kloenne, 1881.

1882. First cross-flue recuperator; Kloenne, 1882; The Hague, Holland.

1887. First parallel flue recuperator; 1887, Kloenne, at Kaiserslautern, Germany.

1889. First vertical flue recuperator, organ pipe design; K. M. Mitchell.

1892. First American design of horizontal and vertical combined recuperator. Parker-Russell, 1892.

1894. First reintroduction of outside producer in combination with recuperators. Bredel, 1894, at Erie, Pa.

1899. First English introduction of iron-clad producers; Mr. Wm. Foulis, Dawsholm works, Glasgow, Scotland, 1899; complete recuperation.

1903. First chamber recuperator; Bredel, 1903, Springfield, Mo.

1904. First application of Siemens system of reintroducing carbonic acid gas under grate; Mr. Henry L. Doherty, probably 1903 or 1904, Denver, Colo.

1905. First twin generator design; F. Bredel, 1905.

1905. First design to lay two generators side by side on same side of bench; S. B. Russell, 1905.

Systems of Vertical Retorts.

[Prepared by Mr. FRED J. MAYER, New York City.]

THE DESSAU SYSTEM OF VERTICAL RETORTS.

It is a well-known fact that, as early as the year 1800, Murdoch experimented with vertical vessels for the purpose of producing gas from coal, and not only were these experiments the first attempts in this direction, but may now be considered as the initiatory steps, which led to the present state of development of the vertical retort system.

Many subsequent attempts to produce illuminating gas from coal in vertical retorts, during the last century, resulted all in complete failures; and not until the early part of the present century did Dr. J. Bueb, of Dessau, Germany, succeed in solving the question of producing illuminating gas from coal in vertical retorts on a practical scale that included economical features greater than those which hitherto existed in carbonizing coal in either the well-known horizontal or inclined retort systems.

It is a strange coincidence that, at the time the results of Dr. Bueb's experiments were made public, it became known experiments for a similar purpose had been made in England, by Messrs. Settle & Padfield, which also pointed at that time to a successful solution of the question of the production of gas in vertical retorts. In fact, the Settle-Padfield invention antedates the Bueb invention, as far as the issuing of the patent for the two inventions by the German Patent Office, is concerned.

Soon after another English invention, that of Messrs. Woodall & Duckham, made its appearance, and since that time many attempts by others have been made to carbonize coal in vertical retorts for the production of illuminating gas. In many instances these experiments were based upon the principles underlying the Bueb invention. Others, again, had for their main object the continuous carbonization of coal in vertical retorts.

The most notable constructions of vertical benches since Bueb's invention, in addition to those above referred to, were evolved by Hasse, Hempel, Kloenne, Horn, Backer, Rummens, Lachomette, Verdier-Teulon, Herring and Young-Glover. None of these constructions is in practical operation to-day, and, therefore, cannot be considered at the present time in making comparison between the various vertical retort systems that have been and are in practical operation.

To thoroughly realize the importance of the theoretical principles upon which the Bueb invention is based, it is necessary to make a comparison with other systems of vertical retorts, that have advanced sufficiently far to actually produce gas for practical use. Only two systems besides the Dessau system can, therefore, be considered, and those are the Settle-Padfield and the Woodall-Duckham systems. In the latter system the principal and characteristic feature of the invention consists of the continuous operation, whilst in the Settle-Padfield system the combination of a continuous coal charge together with an intermittent coke discharge was the principal feature.

The continuous operation of a retort has been tried in many instances for the last 80 years by competent gas engineers; but all attempts were complete failures until Messrs. Woodall & Duckham succeeded with their construction of vertical retorts at the gas works in Bournemouth, England, and they, therefore, deserve considerable credit in having produced the first installation of vertical retorts that could be operated continuously.

The continuous operation is, of course, a most important and desirable feature of coal gas, providing it does not interfere with the economical production and the quantity and quality of coke, gas, tar and ammonia produced.

SETTLE-PADFIELD SYSTEM.

The Settle-Padfield invention cannot be strictly termed a type of vertical retorts. The lower end of the retort is bent sideways, under an angle of 30°, and, therefore, the construction forms rather a combination between the vertical and inclined type of retorts. In this system there is not only a combination of the form of two well-known retort systems, but there is also a combination in the method of operation, inasmuch as the charging of the retorts at the upper end is performed continuously, while the discharging of the coke at the lower end is intermittent, at fixed time periods of about two hours. Only a portion of the coke is discharged at such intervals, leaving a large vacant space in the upper part of the retort for the accumulation of additional coke produced in carbonizing the coal, which is continuously fed into the upper end of the retort. The coal is fed from an overhead storage bin through a feeding cylinder containing double-plungers. From this it will be noted that the entire carbonizing zone is located in the upper portion of the retort and that, therefore, the latter contains a comparatively small area. The upper vacant space in the retort, exposed to the highest temperature, is provided for the purpose of converting the tar vapors into a valuable gas through the radiating heat from the sides of the retort, thus increasing both yield and candle power. In the practical operation of these retorts the expected results were not realized. Frequent interruptions in the method of operation became necessary, for the reason it was found that the charges had not been properly burnt off, and that the plungers of the feeding cylinder became choked with coal dust and tar vapors, preventing their operation.

Trial installations of the Settle-Padfield system were erected in Exeter and Cleethorpe, England, in Rotterdam, Holland and Berlin, Germany. All of these installations were erected for the purpose of producing gas on a practical scale, but as none of them, or any others, is in operation to-day, the system must be considered a failure, and as having been abandoned.

WOODALL-DUCKHAM SYSTEM.

Several installations of small capacity of this system are in practical operation at the present time. As already stated, the important and characteristic feature is the continuous operation. The coal is being fed into the upper mouthpiece of the vertical retort (which latter is tapering toward the bottom), by means of a rotating drum valve, and the coke is removed from the lower mouthpiece by a similar device, necessitating a complete carbonization of the coal charge during the time that the same passes through the length of the retort, which fact establishes the necessity of maintaining a certain relationship between the character of coal and speed with which the same is being passed through the retorts. The character and condition of the coal frequently changes, and, therefore, in order to obtain the best results, it is necessary either to prepare the coal before entering the retorts, or else adjust the speed with which the same is passsd through the retorts suitable to the condition of the coal, so that the proper relationship required for complete carbonization may be maintained between the condition of the coal, temperature and speed with which the coal passes through the retort.

The combustion chamber is located at the upper part of the setting, and, therefore, the highest temperature of the retort is at the upper end, reducing gradually toward the lower end, permitting the decomposition of hydrocarbons, in case voids existed, which would permit the gas produced to come into contact with the highly heated retort surfaces.

The formation of such voids or empty spaces seems unavoidable for the reason that the entire contents of the retort, consisting of completely burnt off coke, partially carbonized and uncarbonized coal, are continually in motion in a downward direction. The cross sectional dimensions of the retort are continually changing from top to bottom of the retort on account of the taper of the latter, and, therefore, the condition of the coal and coke contained in the retort is continually disturbed, for the reason that each particle of the contents is passing through constantly increasing cross-sectional areas. That such voids exist in the retorts is indicated by the fact that there is hardly any resistance to the passing of the gas through the retorts. If steam is introduced in the bottom of the retort for the production of water gas, this fact would assist in forcing the gas out of the retort at a still faster ratio, for the reason that the entire coal gas is produced in the upper portion of the retort. These conditions do not appear favorable to the formation of heavy hydrocarbons, yield and candle power.

It is an undisputed fact that conditions may arise in carbonizing coal in horizontal, inclined or vertical retorts, that will cause a sticking of the charge. Such conditions are principally due to slight deformations in the shape of the retorts, incomplete burning off of the charge, caking of the coke, etc. It is possible that none of these conditions may exist in various portions of the retort at the same time, and under such condition it would be possible to remove the coke from the lower portion of the retort at a faster ratio than the charge would descend from the upper portion of same, providing the charge should stick in the upper portion of the retort. If the sticking of the charge in the upper part of the retort should offer sufficient resistance to the force of the coal feeding device, it is possible that no coal would enter the retort at all, and such condition would

result at once in the local over-heating of the retort in the empty space existing immediately below that portion of the charge that is sticking, which would result in the softening of the material and the destruction of the retort. The great advantage of the Woodall-Duckham system through its continuous operation in closed vessels, consists principally of the reduction of the amount of coal and coke dust in the retort house to a minimum, and the elimination of smoke and steam resulting from quenching of coke.

The question of cost of maintenance and the life of the installation is an important one, especially in larger installations, and in this instance a factor of wear-and-tear has been added to the wear-and-tear of the settings through the introduction of the machinery in constant operation, required for the continuous feeding of coal and discharging of coke. Whether or not such factor is of a serious character must be proven through the practical operation of larger installations in the future.

Bueb System.

This system is the result of experiments made by Dr. Bueb, which had primarily in view the reduction in cost of production, principally labor, as compared with the best known results obtained at the end of the last century with either machine charged horizontal retorts or the inclined system of retorts.

The early constructions were entirely different from those of the present settings, which is due to the fact that Dr. Bueb discovered, after experimenting for some time, that a decided change in the chemical process of coal distillation had taken place, when carbonizing coal in vertical retorts. When this fact became known, many laboratory experiments were necessary in order to establish the exact requirements for the successful carbonization of coal in vertical retorts. Such laboratory work finally resulted in establishing an entirely new theory for the successful carbonization of coal in vertical retorts which differed materially from the theory hitherto adopted for the carbonization of fuel in horizontal and inclined retort systems. It was found that the principal requirements consisted of a completely filled retort, the avoidance of an empty space, a retort tapered towards the bottom, a very high temperature applied to the lower end of the retort, gradually diminishing toward the top of the retort, in proportion to the taper of the latter so that carbonization was completed throughout the entire length of the retort at the same time, and a zone for the off-going gases having a lower temperature than that which would produce decomposition of hydrocarbons.

Not until these important facts had been established did Dr. Bueb succeed in designing the mechanical details of the construction that led to a decided success. Experiments were continued during the early part of the present century, until finally Dr. Bueb succeeded, on May 31, 1905, in supplying the city of Dessau, of 65,000 inhabitants, with gas produced exclusively in vertical retorts, and, therefore, this date must be considered the birthday of this new system of coal carbonization.

It required another year in order to thoroughly establish the practical value of Bueb's invention, and, therefore, the actual development and introduction of the new method of coal carbonization did not take place until the middle of 1906. Since then the development has been so rapid that, at the present moment, over 4,000 retorts are in practical operation and under construction, and, therefore, no other invention in the field of gas industry has enjoyed a like rapidity of introduction to practical application.

Simple as the matter may appear to-day, it required continuous close application of study and laboratory work, numerous practical experiments and the expenditure of hundreds of thousands of dollars in order to develop and produce the present construction of the Bueb system of vertical retorts.

The principal theory of the Bueb system consists of producing from coal an illuminating gas poor in naphthaline and free from cyanogen, rich in ammonia, yielding a tar in the form of a liquid, dark-brown oil, poor in carbon, and coke of increased value as compared with coke produced in horizontal and inclined retorts.

To increase the gas production beyond the amount obtainable from the coal, the construction is so arranged that during the last two hours of the carbonizing period steam may be introduced in the bottom of the retorts to produce hydrogen. It is extremely questionable, however, if such an arrangement is desirable under all circumstances, as the mixed gas suffers a reduction as compared with the straight coal gas, both in illuminating power and calorific value, and as the future of artificial gas lies principally in the direction of its consumption for fuel purposes, the maintenance of a high calorific value is of great importance.

The introduction of public service commissions in many of our large cities will probably result, through their careful investigations, in the abandonment of the candle power standard and the substitution of the heat value standard, and the vertical retort system is eminently suitable for the production of gas of high calorific value.

The production of water gas in vertical retorts is only possible at the expense of consumption of carbon contained in the coke without affecting the contents of its ash. In other words, the ash contained in the coke, after the completion of the water gas production, will increase in percentage in proportion to the amount of coke that has been consumed for the production of water gas. The increase in ash will result in a corresponding reduction in the value of coke.

During the entire period of distillation no changes take place in the mechanical conditions existing in the interior of the retort, and, therefore, the carbonizing results remain uniform per time unit throughout the entire period of distillation. This result is only attributable to the uniformity of conditions under which the coal is carbonized. Carbonization takes place from the outer surfaces of the retort toward the center of same, and as it is a well-known fact that in the distillation of coal the hydrocarbons are liberated first, and the non-illuminating gases, principally hydrogen, last, the uniformity of gas production is easily explained, through the fact that the coke layers adjacent to the retort walls are still giving off hydrogen gas during the latter period of the distillation, when at the same time from the interior of the charge hydrocarbons are being liberated.

The following can be considered the principal advantages obtainable from the operation of the Dessau vertical retort system:

1. Increase in yield per square foot of retort surface.
2. Increase in yield per ton of coal, without any reduction in quality of gas.
3. Increase in yield, per retort and per day.
4. Increase in yield, per man.
5. The gas is almost free from naphthaline.
6. The gas contains only traces of cyanogen.
7. An increase of from 30 per cent. to 40 per cent. of ammonia.
8. The tar is poor in carbon, and contains a high percentage of valuable oils.
9. There are no stoppages in ascension pipes or hydraulic mains.
10. Scurfing of retorts is reduced to a minimum.
11. Retort house labor is materially reduced and consists of a few operations with levers that can be performed by any ordinary laborer.
12. Greater value of coke on account of its increased density and decreased amount of breeze.

The cost of the retort house labor is not only very materially reduced, but the labor can be performed under extremely favorable conditions, as the operators do not suffer from any radiant heat, for the reason that the highest temperature is at the lowest end of the retort. Another important advantage consists in the application of gravity force in a most perfect manner for the charging and discharging of the retorts, avoiding all complicated machinery or mechanical apparatuses. The application of complicated machinery, for instance, such as is applied in connection with horizontal retort installations, requires skilled labor both for the operation of the machinery, as well as for the repairs to same, which counteracts to a large extent the saving produced by the application of such machinery. A further advantage of the Bueb system is the access of the retorts from both the top and the bottom ends. Whenever carbonization of coal is performed in retorts made of fireclay it is necessary to exercise a close and continuous inspection of the condition of the retorts, as otherwise defects of the retorts that may develop, remain undiscovered, which would certainly result in a most disadvantageous effect upon the operating results. Fireclay retorts are always liable to crack through the effect of expansive forces, local overheating, sudden changes in temperatures and other causes, all of which are liable to exist, particularly when steam is introduced into the bottom of the retorts for the production of hydrogen at the same time that coal is carbonized in the upper portion of the retorts. Therefore, the retorts must be submitted to continuous and careful examination, as undiscovered cracks permit of drawing in furnace gases in case the retorts are working under vacuum, or result in loss of gas in case the retorts are operated under pressure. The accessibility of the retort from the lower end further affords an opportunity to completely discharge the retorts, in case the coke should stick, by the application of a bent rod inserted through the bottom mouthpiece.

Cost of maintenance and charge for repairs are reduced to a minimum, as the fact has been established that local repairs to any portion of the retort can be made without dismantling the entire setting. Such local repairs can be accomplished by the cutting of holes through the side of the bench walls and removing and resetting any portion of the retort that may have become defective.

The following is a detailed description of the setting itself:

The details of construction are substantial and well-tried in every respect. The generators, together with the recuperators, are constructed directly upon the bench foundation. The retort chamber is supported by a heavy steel framing and cast iron bearing plates, to which are also attached the lower mouthpiece and lids.

The generators extend from the foundation to the top of the bench, and are so constructed that the top of the same remains in a comparatively cool condition, avoiding all difficulties arising from air leakage through charging cover door frames, on account of the warping of the castings exposed to excessive temperatures. Each generator is supplied with a vaporizer located underneath the ashpan, and the water is evaporated by the off-going products of combustion before the same enter the main smoke flue. The vapors are carried into the primary air flues and enter the generator under the grate, together with the primary air. The effectiveness of this arrangement has been proven by the fact that the clinkering of the furnace is required only at time intervals of 48 hours when coal is carbonized that does not contain over 1 per cent. sulphur.

The carbon monoxide produced in the generators enters the combustion chambers at the base of the retorts, and the secondary air is admitted in such manner that combustion takes place between the retorts. The flame and furnace gases traverse the setting in a serpentine line to the top of the setting, from where the products of combustion are transferred to the top of the recuperator, passing downward through the latter to the exit flue of the generator. The arrangement required for the adjustment of temperatures between the bottom and top of the retort is such that a gradual reduction takes place towards the top, in proportion to the taper of the retorts, so that carbonization is completed in all parts of the retorts at the same time. The taper of the retorts has been established by practical experiments, and is such that the coke slides out of the retorts without difficulty.

The retorts are made in sections, permitting replacement of each section without disturbing the other. The removal and replacement of any retort section is easily accomplished by cutting a hole into the front wall immediately opposite the retort section, which requires to be replaced. The front wall of the setting is provided with special insulating material for the purpose of reducing radiation of heat to a minimum. There is no loss of heat by radiation from the opposite wall, as the generator and recuperator are located immediately in front of same.

Sight-holes for observing the temperatures are placed in the front wall, as well as in the recuperator flues, to permit of exact temperature regulations in a most perfect and easy manner. Actual operating results have proven the fact that temperature will respond to change in adjustment, in from one to two hours, a fact highly appreciated by the practical gas maker. The draught required for economical combustion is comparatively low, due to the large flue areas, offering a minimum amount of resistance.

The temperature of the off-going products of combustion averages from 750° to 800°, notwithstanding the fact that the retorts are operated under exceedingly high temperatures, indicating a most perfect utilization of the heat energy of the combustible gases.

All parts of the setting subjected to high temperature must necessarily be constructed of specially prepared material to assure long life and durability. Present indications point to a considerable increase in the life of this setting over horizontal and inclined settings when operated under proper conditions.

The upper or charging mouthpieces are of the self-sealing type, so arranged that they support the surrounding operating platform. To the upper mouthpieces are connected the take-off pipes, connecting with the dip-pipes of the hydraulic main. The take-off pipes are supplied with self-sealing lids, in such location that they permit of quick and easy cleaning when such is required. The off-going retort gases have a very low temperature, and, therefore, stoppages are a rare exception, especially when regular attention is paid to the condition of these pipes. In many instances it has been found that the cleaning of these pipes once in every week was entirely sufficient to maintain proper operating conditions.

Each bench is provided with a separate hydraulic main having large cleaning pockets. Each pocket is supplied with a removable pan for the purpose of accumulation and easy removal of the small amount of heavy tar that may be carried over from the retorts. These pans are suspended immediately below the dip-pipes, and materially assist in maintaining the hydraulic main in a perfectly clean condition at all times, particularly as the tar consists principally of a dark-brown oil, low in carbon. The gas, as well as the tar take-off pipes, are located at one end of the hydraulic main, the tar take-off pipe being provided with an independent seal, preventing the return of gases and vapors through the tar main, from the tar and ammonia wells.

The lower retort mouthpieces are also of the self-sealing type, which are operated from the outside of the benches by a system of racks, pinions, levers and chain gears, so arranged that any mouthpiece may be engaged or disengaged with the operating mechanism. Each of the mouthpiece lids is counterbalanced, reducing the power required for operation to a minimum.

In front of the benches, on the same level with the operating mechanism, is located a platform, permitting the inspection of the operating mechanism and observation of temperatures in lower portions of bench. Another platform is located in front of the hydraulic main for the purpose of cleaning the latter, as well as the standpipes, when such should become necessary.

The retorts and generators are charged by means of suitable charging hoppers, traveling upon tracks suspended from the girders which support the elevated coal and coke bins. Four hoppers are required for the complete cycle of operation. One of the hoppers supplies coke to generator furnaces, two hoppers supply the lower portion of the retorts with coke breeze of exactly measured quantities for the purpose of filling the lower mouthpieces, and that portion of the retort which is concealed in the masonry bed and not affected by direct action of heat. The fourth hopper is required for the charging of coal to the retorts, also in exactly measured quantities. The discharge valve of this hopper is provided with a special device, by which the charge is deposited in such manner that the fine coal is immediately adjacent to the retort sides, whereas the coarse coal forms the central portion or core of the charge. As carbonization takes place from the sides toward the center of the core, the gases are passing off through the core of the charge, as the latter offers the least resistance, on account of the rapid formation of a layer of coke against the retort sides, due to the direct action of high temperatures (from 2700° to 2800° F.) upon the latter in the bottom of the combustion chamber. The entire coal charge is contained in that portion of the retort only, which is exposed to direct action of heat. The coke breeze used as a supporting bed for the coal charge is by no means lost; to the contrary, the same is recovered in large pieces of great density, due to the absorption of a small quantity of tar in the early period of carbonization, and the action of the radiant heat from the incandescent coke during the latter part of the carbonizing period. The time required for complete carbonization varies from 8 to 10 hours, and is dependent upon the character of the coal.

After carbonization has been completed the entire coke contents of the retorts are easily discharged by gravity force through the lower mouthpiece, on account of the absolute uniform character of the coke throughout the entire length of the retort. Should a charge stick, however, through partial deformation of the retort or other causes, the same is easily removed by the insertion of a bent rod through the lower mouthpiece, which easily overcomes what otherwise would seem to be serious difficulties. The coke is discharged over a movable chute, traveling upon rails, immediately below the retort to the hot coke conveyor, which latter is located outside of the bench. With the conveyor in this location, access to the bottom ends of the retorts is assured at all times.

As no machinery of any kind, except for the handling of coal and coke, is required for the operation of the benches, and as no intermediate operating floors are necessary, the floor area of the retort house can be reduced to a minimum. In semi-tropical or tropical climates all that would be necessary would be a covering of light construction, supported immediately upon the buckstays of the benches, avoiding entirely the construction of an expensive retort house.

The cost of operating the benches is exceedingly low. There is no difficulty in obtaining a gas production of from 200,000 to 250,000 cubic feet per day and man. This amount can be still further increased when steam is introduced for the production of water gas, but the economy of such water gas production is questionable, for the reasons already stated.

Experiments with Westmoreland and West Virginia coal, on a

practical operating scale, have produced the following results referring to yield and candle power:

Gas yield, per pound, of coal, Westmoreland, cubic feet....	5.6
Gas yield, per pound, of coal, West Virginia, cubic feet....	6.9
Candle power, Westmoreland	14.85
Candle power, West Virginia	14.25
Coke yield, Westmoreland, per cent.....	73.3
Coke yield, West Virginia, per cent.....	73.82

The candle power was determined by London Argand "Sugg" with a gas consumption of five cubic feet per hour.

Great credit is due to Dr. Bueb for his untiring and continuous efforts to produce coal gas in vertical retorts under practical conditions, notwithstanding the many reverses he met with during the early part of his investigation, and in this connection it must be stated that Mr. E. Koerting, the Managing Director of the Imperial Continental Gas Association, of Berlin, rendered a most valuable co-operation and assistance in the development of the Bueb vertical retort system.

The first installation of the Bueb vertical retort system in this country is now in course of construction for the Providence Gas Company, of Providence, R. I., and we are therefore indebted to the progressive spirit of Mr. John W. Ellis, the President of the Company, for an early opportunity to investigate the advantages of the Bueb process, when operated under American conditions.

The Development of the Ammonia Industry in Gas Works During the Last Fifty Years.

[Prepared by Mr. R. W. Hilgenstock, Engineer, Leipsig (Plagwitz), Germany.]

When one looks back and lets the past half century pass his mental eye, there will appear a picture of very characteristic looks. In the beginning of it, we see the railroads hardly started, pig iron and steel are made in a very expensive and tiresome way, rolling mills, mostly driven by water power, furnish rails and other structural iron in a very clumsy shape; the chemical industry is in its childhood yet, and only a very few of the chemicals known in our days are made in bigger quantities; gas works, I guess, were only in larger cities in operation. By-and-by, however, the picture changes, and we see better equipped railroads and larger mills, and inasmuch as the gas works and chemical works have grown, the chemical preparations show an increase also. Especially, two big groups take our interest: that of ammonia and that of tar. It was only natural that, with the development of the chemistry, these two contents of the coal should evolve an industry which to-day gives employment and wages to many thousand employees and workmen, and the gas works can be proud to take the glory for having given birth and raised these industries.

Of course, in the beginning, means for the recovering of ammonia contained in the gas liquor were very simple, and big losses could not be avoided, until the nature of ammonia became more and better known to the chemists, who in turn gave their experience to the builders of chemical apparatus, so that to-day almost every concern manufacturing ammonia stills and ammonia apparatus can produce machines of excellent quality. Looking back, however, once more, we find that the gas liquor, the recovering of which I presume as known to every reader of the Journal, is boiled in simple boilers; the escaping ammonia gases are either caught in sulphuric acid and sulphate of ammonia is recovered as end product, or they are condensed and concentrated ammonia liquor is made. Many accidents and explosions, due to blockage of the pipes with carbonate of ammonia, and crustation of the boilers with calcium sulphate (gypsum), occurred, the operation was very irregular and many a manager of gas works, afraid to tackle this matter, rather preferred to let the gas liquor go to the sewer than to endanger his and his employees' welfare and lives. Soon, however, the boards of health of the cities made an end of this nuisance, and the management was forced to get rid of the liquor in such manner that the water of the rivers was not vitiated, killing the fish, and the wells in the neighborhood of the gas works were not filled with gas liquor, that had filtered through the ground. By this time, of course, the distilling apparatuses were very much improved, so that the boiling of the gas liquor was no longer connected with danger, and instead yielded a handsome profit to the owners of the works. Heat naturally had to be applied in every case to drive off the ammonia, which was contained in gas liquor, and the apparatuses were constructed to use either coal, direct steam or indirect steam in heating coils. Tidy made experiments with the three above mentioned means of heating and found that 7,000 gallons of gas liquor needed:

By heating with coal—22 hours giving a yield of 90 per cent. of the total ammonia.

By heating with indirect steam—18 hours giving a yield of 92 per cent. of the total ammonia.

By heating with direct steam—14 hours giving a yield of 98.5 per cent. of the total ammonia.

Grüneberg was about the first who constructed a sectional apparatus which was heated by open fire, but which nevertheless gave fair results; at the same time he took care that the crust of lime, which was due to the pumping of milk of lime into the apparatus to set free the fixed ammonia, could be very easily removed. A further progress in development of the ammonia industry was the apparatus constructed by Grüneberg and Blum. They applied steam, and the style of this apparatus has been the foundation on which almost every other apparatus has been built. Lack of space forbids me to go into further details of this apparatus. They are described in Lunge's "Coal Tar and Ammonia," where the full description can be found. Numerous are the types and constructions of the ammonia apparatus, which came on the market new; most of them were built to produce concentrated ammonia liquid and only a few were installed to make sulphate of ammonia. Of course, I have American gas works in mind. Here in Germany the opposite is the case. The market for sulphate of ammonia as a fertilizer is very good, and inasmuch as the process of manufacture is very simple, most of the gas works prefer to make sulphate of ammonia instead of concentrated liquor. The United

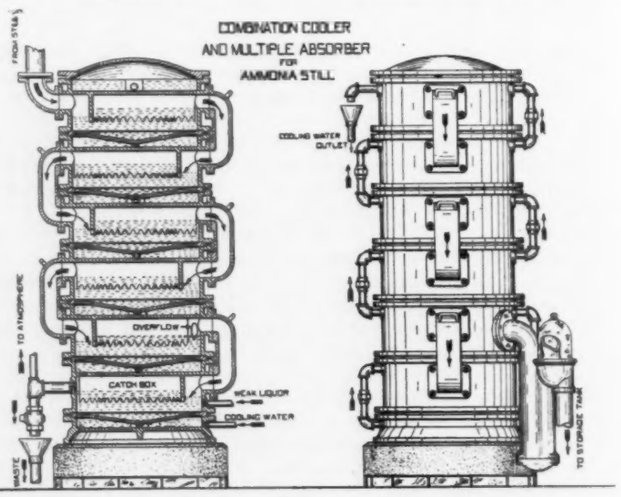


Fig. 1

States, however, with her rich soils, does not need so much artificial fertilizer, and the gas works, having good customers in the large packing houses and artificial ice works, who use a good deal of ammonia in form of liquid or anhydrous ammonia, turn their gas liquor into concentrated ammonia liquor and ship it to the large chemical factories; here the liquor is distilled and purified again and the ammonia is recovered as aqua or anhydrous ammonia. Only a few gas works make aqua ammonia direct in the United States. To the writer's knowledge there are only two aqua ammonia plants: one at the New Haven (Conn.) Gas Light & Coke Company, built by Messrs. Bartlett, Hayward & Co., of Baltimore, and one at the Indianapolis (Ind.) Gas Company, installed by the Gas Machinery Company of Cleveland, Ohio. I am sorry I must state again that, on account of lack of space, I cannot go into a detailed description of these plants, but it may follow in one of the later editions of the Journal. The next lines shall give a description of the most up-to-date distilling apparatus as they are built by the different construction companies to-day.

Figure 1 shows a still of the Western Gas Construction Company, Fort Wayne, Ind. The gas liquor which leaves the overhead tank is preheated by the outgoing steam ammonia vapors and afterwards travels down section to section, meeting always hotter steam, which travels on the counter current principle; in the so-called volatile still, comprising the sections above the vessel called liming leg, the free ammonia, that is ammonia not bound to sulphuric, hydrochloric, or nitric, acid is driven off; the compounds of the ammonia with these acids, must be decomposed by lime, which is pumped in in the form of milk of lime. The calcium

oxide sets the bound ammonia free and this process takes place in the liming leg and the adjoining sections; leaving the lowest sections, the former gas liquor does not contain more than 0.003 per cent. NH3. The vapors, which leave the top section of the still are either condensed in a cooler as shown in Figure 2, and concentrated ammonia liquor containing from 16 to 18 per cent. NH3 is recovered, or they are brought into a lead lined saturator, containing diluted sulphuric acid of about 40 degrees to 42 degrees and sulphate of ammonia is recovered as end products. The saturator will be described later on.

Two similar stills, built by The Gas Machinery Company, Cleveland, Ohio, are shown in figures 3 and 4. The principle is the same as that of the Western Gas Construction Co., only the construction differs somewhat. While the still in Figure 1 has inside overflows for the gas liquor, the Gas Machinery Company very lately has arranged them outside, so that they can be cleaned very easily, in case they should be blocked up with tar and other heavy matter. In Figure 4 a larger still for the manufacture of concentrated liquor is shown. There the construction is almost identical with that in Figure 1; milk of lime, to set free the fixed ammonia, is prepared in a lime-mixer and steadily pumped into the liming leg; for smaller sizes of stills, this mixer can be spared and a steam injector may be installed, which works very satisfactorily, to pump the milk of lime into the liming leg of the still. In Figure 5 an apparatus is shown which will be of interest to managers and superintendents of very small gas works. It is built and put on the market by Karl Francke, Bremen. It has the advantage that the waste liquor can be re-used again in the washers and scrubbers after it leaves the still and is cooled off. The operation of the apparatus is in short as follows: The gas liquor is filled into the wrought iron still and heated by an open fire so that the ammonia gases will leave the still on top and enter the cooler at the right hand side, where they are condensed by means of cooling water, so that a liquor of about 8 to 10 per cent. strength of ammonia is obtained, which can be filled into a barrel and shipped to chemical factories, which will pay a fair price for it. In case there is an overhead tank for water, the cooling water that leaves the cooler can flow back into this tank as it will hardly take up any heat from the ammonia gases in the condenser. The waste liquor, after it leaves the still, is brought into brick basins, located outside of the building, where it cools off and later, as stated above, is used again as washing fluid in the washers or scrubbers. Of course, this waste liquor will accumulate, and in order to prevent losses of ammonia in letting it

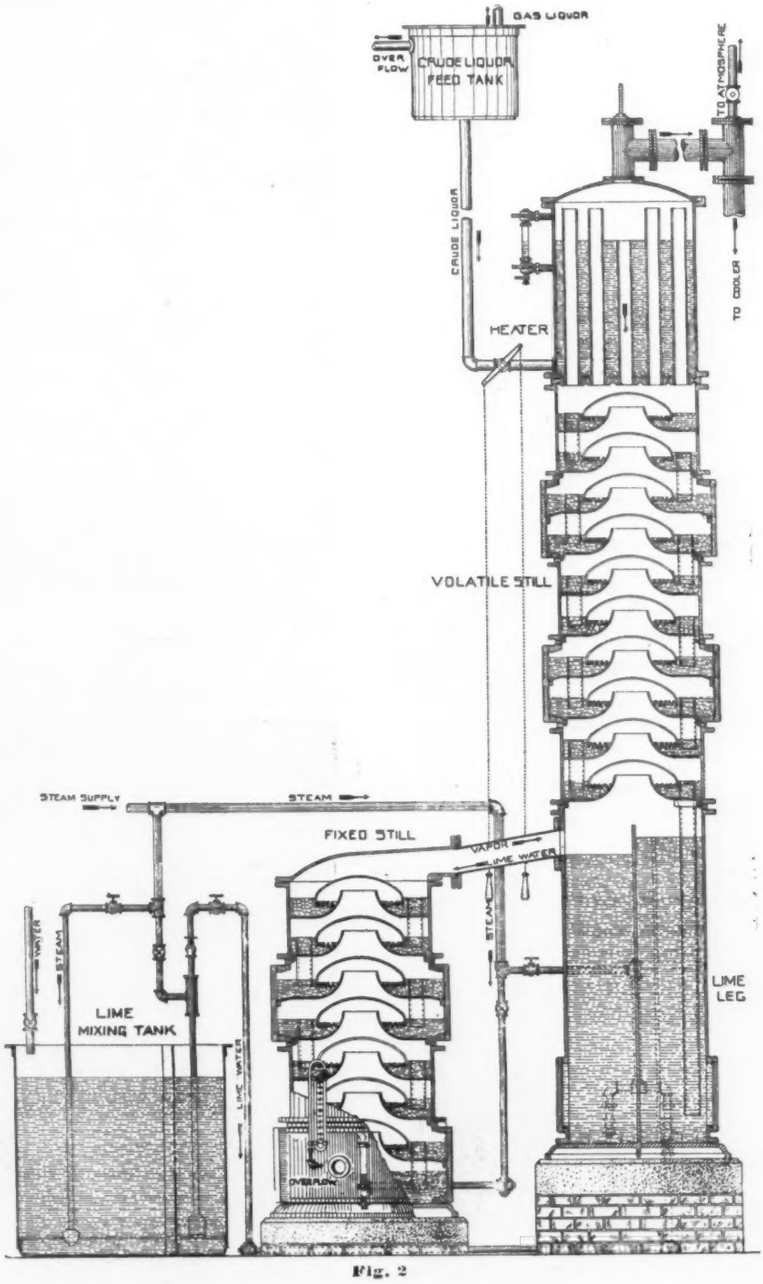


Fig. 2

run into the sewer, part of the waste liquor is vaporized in a small steel tank. The heat to do this is furnished by the waste gases of the retorts or boilers. The percentage of fixed ammonia will thus increase in the liquor that stays in the tank; by-and-by it will be just as high in percentage of ammonia as that which is gained in the condenser, so that the two liquors can be mixed and yet the strength of the ammonia does not decrease. In using this process, which is protected by patent, the smaller gas works have an opportunity to increase their net profit considerably, and this the more, as the installation of the apparatus is by no means a great expense.

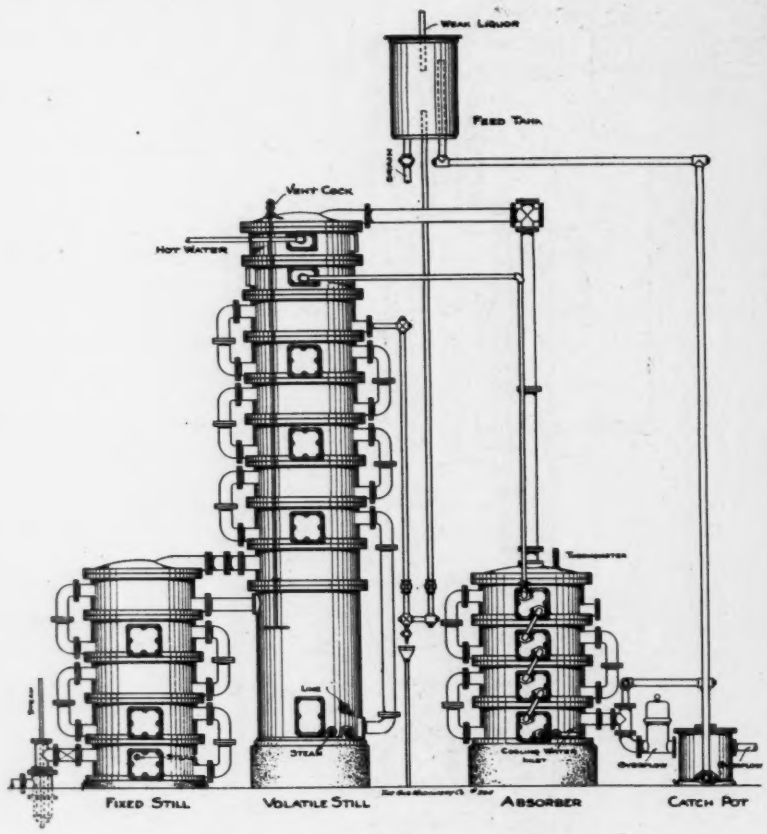


Fig. 3.

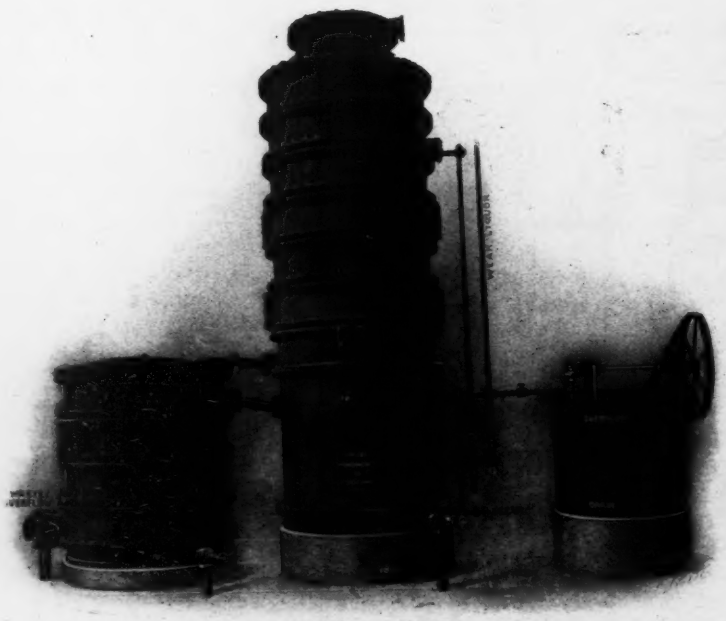


Fig. 4

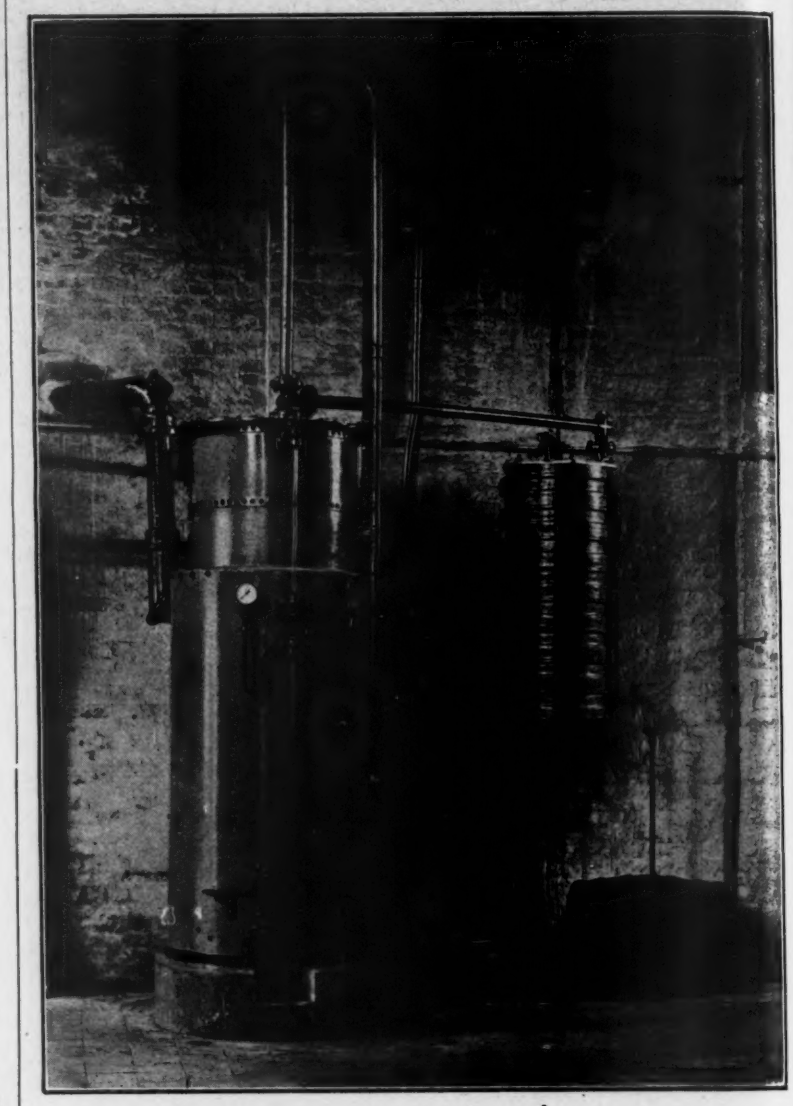


Fig. 5

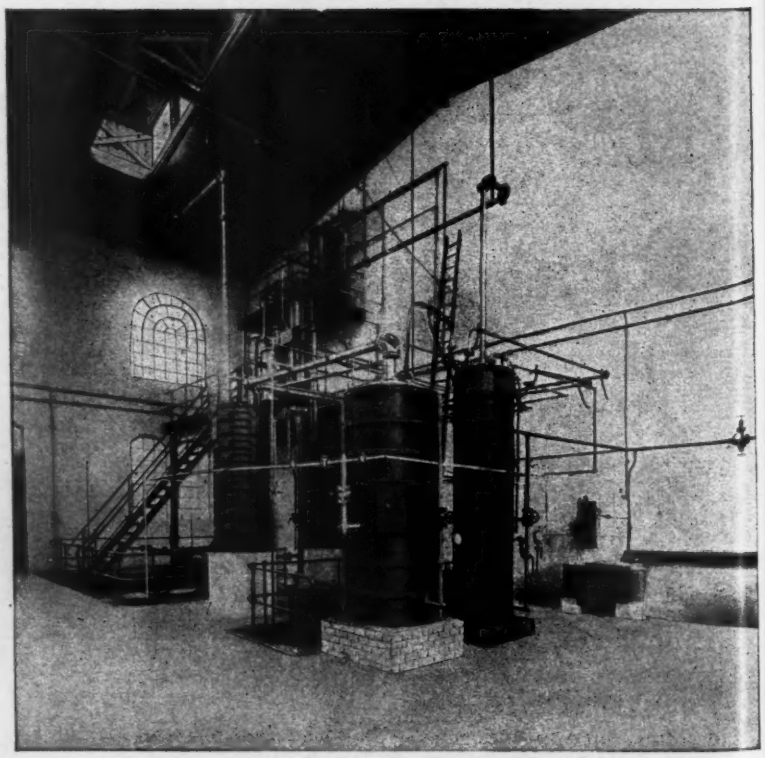


Fig. 6

In Figures 6, 7 and 8, apparatus of the Berlin Anhalter Machinen Fabrik, in Berlin, are shown. Figure 6 represents an apparatus to work up small quantities of gas liquor into concentrated liquor. Fig. 7 is the view of a concentrating plant at the city gas works in Breslau (Silesia), and Fig. 8 shows the section through a saturating box used in making sulphate of ammonia. The ammonia vapors from the still enter the box through the lead pipe, which dips into diluted sulphuric acid. To prevent the escaping of obnoxious gases into the workroom, a lead bell, G, is arranged which again is provided with a seal containing weak sulphuric acid, so any ammonia that should escape, especially when the acid is beginning to become neutral, is caught here. After this seal, the waste gases pass a lead tank in which baffle-plates are arranged to keep back as much as possible the water that is carried mechanically with the gases. In many cases these waste

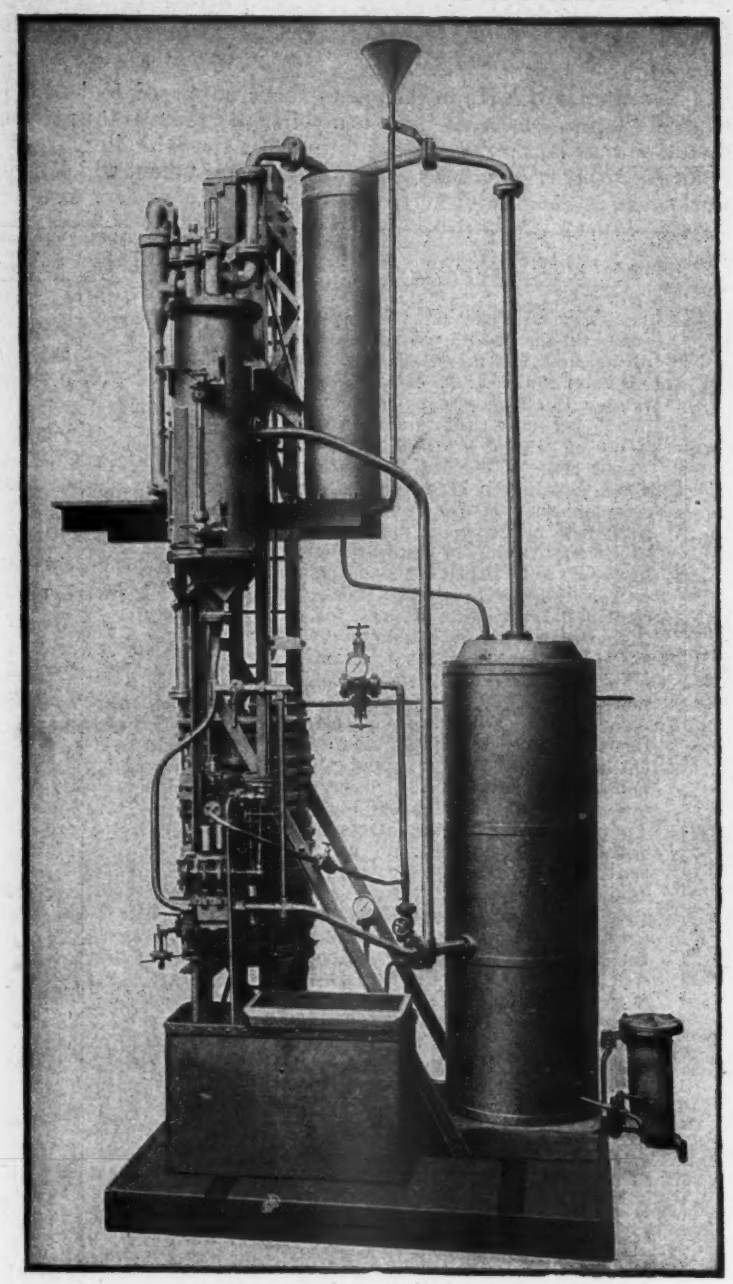


Fig. 7

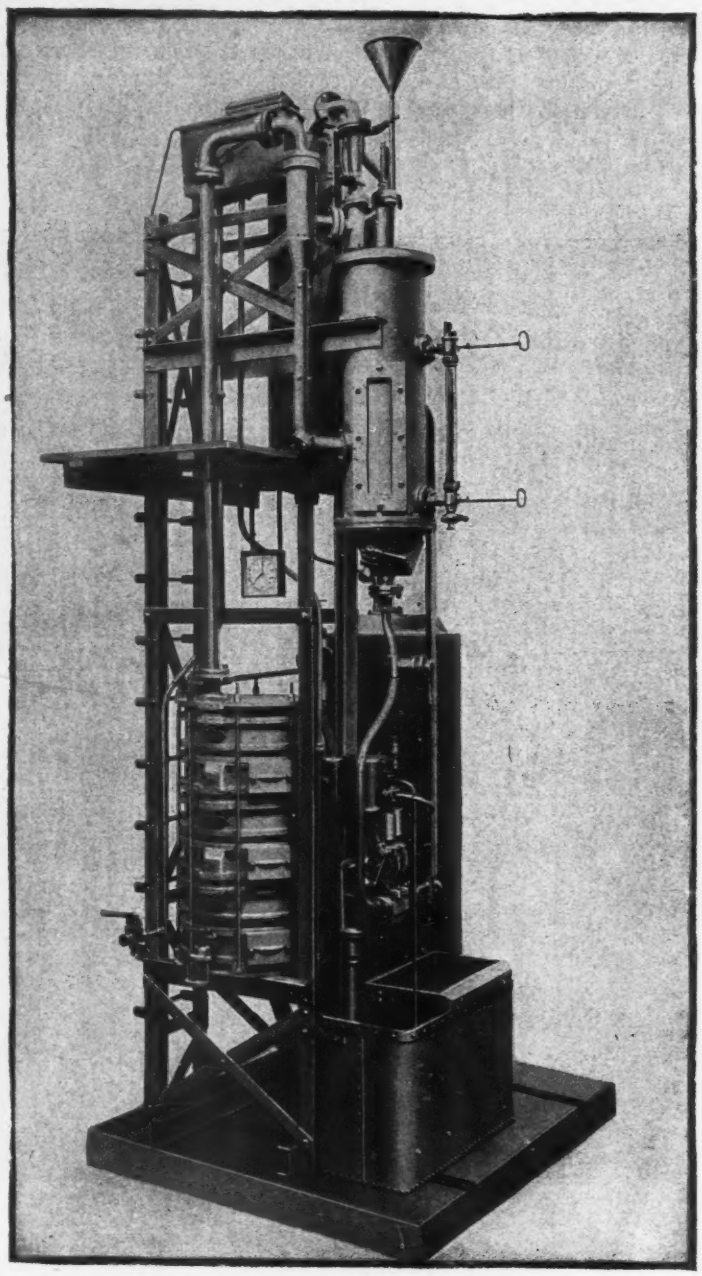


Fig. 7a

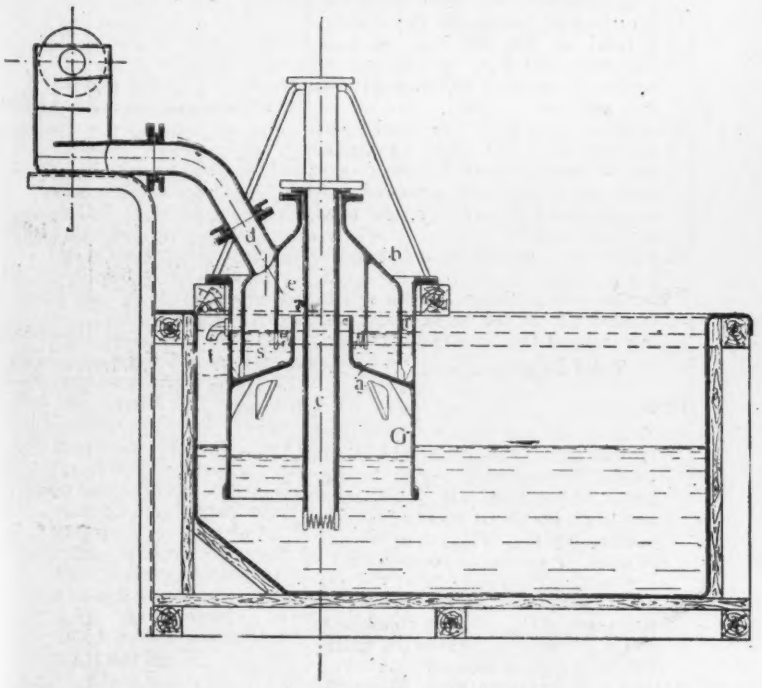


Fig. 8

gases are used to preheat the raw gas liquor before it enters the still, and the saving of steam by doing so is worth while to consider. Figures 9, 10 and 11 show apparatus built by Julius

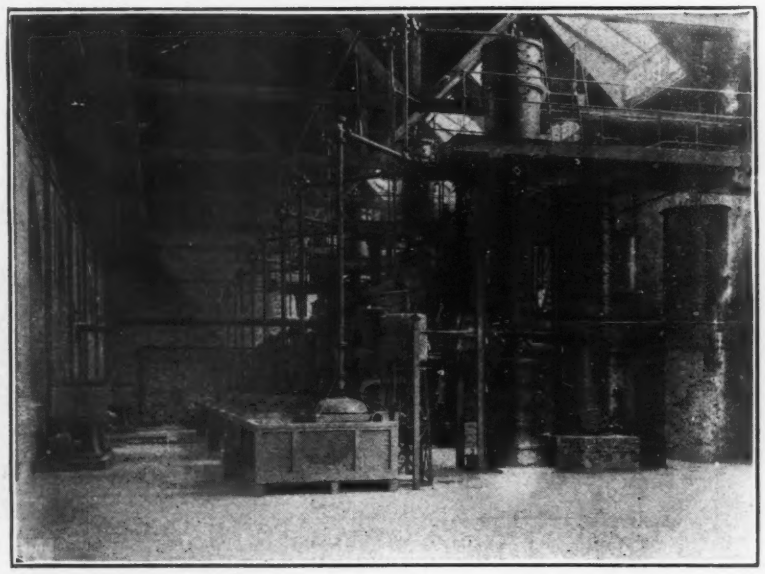


Fig. 9

Pintsch, Berlin. Fig. 9 is a sulphate of ammonia plant in the Berlin city gas works; Fig. 10 shows a concentrating plant at the city gas works in Pforzheim, and Fig. 11 is an aqua-ammonia plant in the city gas works in Berlin. There are numerous other constructions yet, to describe all of which would take too much time and space, and I think the pictures which are shown give an idea of what has been accomplished in the last half-century. Espec-

ially the older gas men may make a comparison of the apparatus which they had at their disposition when they started their careers with that which they have in operation now. Many of them may have helped in their way to bring the ammonia business to the standard of to-day, which, as stated in the beginning, yields the gas companies a fair profit and helps pay the heavy expenses which

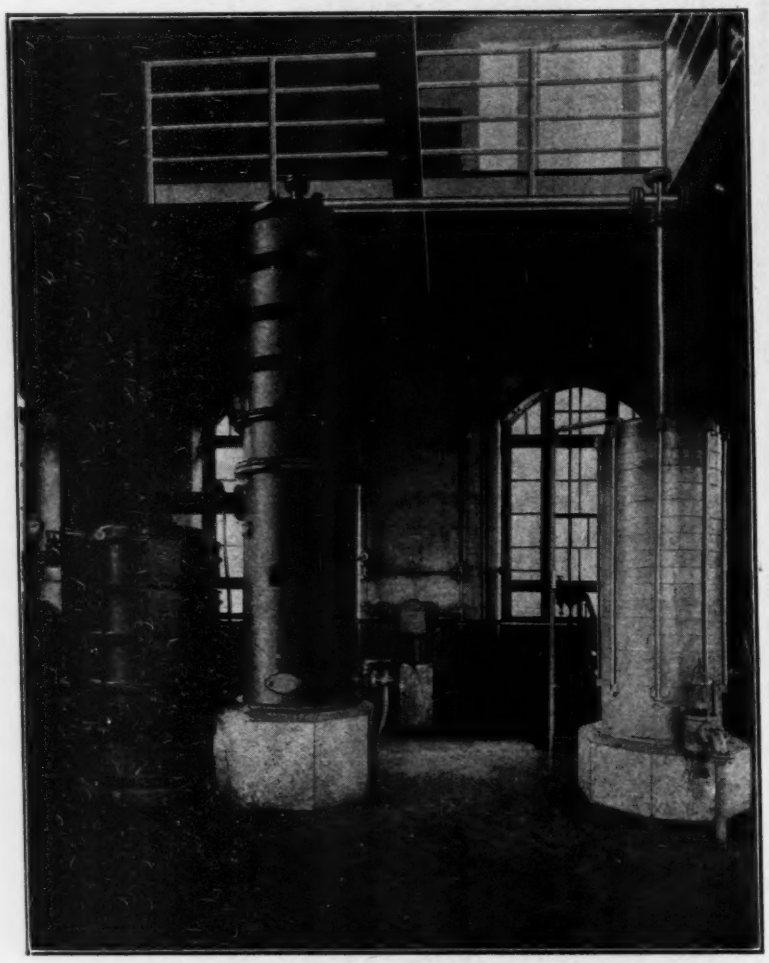


Fig. 10

Fig. 11

the gas industry has to meet in our days. The following tables give the operating expenses, gross and net earnings for ammonia plants making concentrated liquor 16 to 18 per cent. NH3, high concentrated liquor 25 to 30 per cent. NH3, sulphate of ammonia, aqua ammonia and anhydrous ammonia. The figures are given on German basis, but in taking the prices and figures which are paid in the United States one can easily figure out what he may gain by installing this or that kind of an ammonia plant.

Operating expenses for plants working on concentrated liquor and sulphate of ammonia.

The contents of NH_3 in the gas liquor is supposed to be 1.8 per cent; it is presumed that there is a boiler to produce the necessary steam, so that it is not necessary to install a special boiler.

For figuring 1,500 cubic meters of liquor are taken, which can be worked up in 150 days.

Pos.	DEFINITION.	Concentrated Liquor 16—18% NH_3	Concentrated Liquor 28—30% NH_3	Sulphate of Ammonia
	EXPENSES.			
1.	Interest and amortisation (5+2 per cent.) for the buildings—7 per cent. of the capital of marks 2,500.	mks. 175.	mks. 175.	mks. 175.
2.	Interest and amortisation of the apparatus with all necessary machinery (5+10 per cent.) for concentrated liquor of 16 to 18 per cent. NH_3—15 per cent. of the capital, marks 6,000.....	900.	.....	.....
3	Interest and amortisation of the apparatus with all necessary machinery (5+10 per cent.) for concentrated liquor of 28 to 30 per cent.—15 per cent. of the capital, marks 7,000....	.....	1,050.	.....
4.	Interest and amortisation of the apparatus with all necessary machinery (5+10 per cent.) for sulphate of ammonia—15 per cent. of the capital, marks 7,000.....	.....	.....	1,050.
5.	Fuel for boilers. For driving off carbonic acid and distilling 1 cbm. of gas liquor—(264 gallons) about 450 pounds of steam are used; consequently for 1.500 cbm.—675,000. To produce this steam, about 43 tons of coal are needed. Figuring the ton with marks 20, then the fuel amounts to..... ...	860	860.	860.
6.	Lime to decompose the so called fixed ammonia compounds. Supposing the gas liquor contained 0.36 per cent. fixed N_3 Hi. *e.* the fifth part of the total ammonia (1.8 per cent.), then 264 gallons of gas liquor would need about 20 lbs. of lime; consequently for 1,500 cbm. or 396,000 gallons—30,000 lbs. Figuring the ton of lime stone with 16 marks. then the expense for lime would be,	192.	192.	192.
7.	Cooling water for the coolers. For cooling purposes about double the amount of the gas liquor, which is worked up, will be used, consequently 792,000 gallons. Figuring 1 cbm —264 gallons with 0.05 marks we get.....	150.	150.	150.
8.	Sulphuric acid for binding the ammonia. Gas liquor of 1.8 per cent. NH_3 contains in 1,500 cbm. 60,750 lbs. of NH_3. About four times of this amount will be needed on sulphuric acid, having 60° B.; making a total of 243,000 lbs. of acid. Figuring 100 Kg. or 225 lbs. of acid with marks 4.50, then 243,000 lbs. will cost.....	.....	.....	4,860.
9.	Wages for laborers. The yearly production of 1,500 cbm. gas liquor can be worked up in 150 days. For each day one laborer is needed, getting marks 4 50 per day; the total wages would be....	1,350.	1,350.	1,350.
10.	Expenses for repairs and breakable parts.....	50.	50	50.
11.	Expenses for packing, waste, oil, illumination of the work room, taking away of the lime residuals, etc.	150.	150.	150.
	Total Expenses.....	3,827.	3,977.	8,837.
	RECEIPTS.			
1.	1,500 cbm. of gas liquor, containing 1.8 per cent. NH_3 yield about 150 tons of concentrated liquor having about 18 per cent. NH_3. Figuring one ton with about marks 144 (containing 180 Kg. NH_3) then we get,	21,600.	.....	.....
2.	1,500 cbm. of gas liquor containing 1.8 per cent. NH_3 yield about 108 tons of concentrated liquor having 25 per cent. NH_3. 1 ton, containing 250 Kg. NH_3 is paid with marks 205, so we get a total of	.....	22,140.	.....
3.	Sulphate of ammonia gives about the same weight as sulphuric acid is used, *i. e.*, 108,000 Kg. (—243,000 lbs.) 100 Kg. of sulphate of ammonia are paid with marks 24, for 108,000 Kg. we receive.....	.....	.....	25,920.
	Total Receipts.....	21,600.	22,140.	25,920.

	Deducting 2 per cent. unavoidable losses on ammonia	450.	450.	450.
	Leaving Receipts	21,150.	21,690.	25,470.
	RECAPITULATION.			
1.	Total Receipts	21,150.	21,690.	25,470.
	Total Expenses	3,287.	3,977.	8,887.
2.	Leaving a surplus of marks	17,323.	17,713.	16,633.
	Figuring the value of the gas liquor, which may have been sold before at marks 0.25, we deduct from this surplus	6,750.	6,750.	6,750.
	Leaving a net profit of marks	10,573.	10,963.	9,883.

Operating expenses for plants working on technically and chemically-pure aqua ammonia and anhydrous ammonia, containing 99.9 per cent. NH_3.

Daily capacity, 20 cbm. (=5,280 gallons) gas liquor containing 1.8 per cent. NH_3. It is presumed that a boiler is installed, to produce the necessary steam. The figures are based on 3,000 cbm. gas liquor, which are worked up in 150 working days.

Pos.	DEFINITION.	Aqua Ammonia Technical Pure	Aqua Ammonia Chemical Pure	Anhydrous Ammonia
	EXPENSES.			
1.	Interest and amortisation for the buildings (5+2 per cent) amounting to 7 per cent. of capital of marks 4,000.	mks. 280.	mks. 280.	mks. 280.
2.	Interest and amortisation for the apparatus for technical pure aqua ammonia (5+10 per cent.) amounting to 15 per cent. of the capital of marks 16,000	2,400.	.....	.....
3.	Interest and amortisation for the apparatus for chemical pure aqua ammonia (5+10 per cent)—15 per of marks 16,000	.....	2,400.	.....
4.	Interest and amortisation for the apparatus for anhydrous ammonia (including 500 steel cylinders at marks 45) 5+10 per cent.—15 per cent. of cent. 44,500 marks	.....	.....	6,675.
5.	Fuel for boiler. For eliminating carbonic acid and heating 1 cbm. gas liquor 250 Kg. steam are consumed; consequently for 3,000 cbm.—750,000 Kg. of steam. To raise this steam 107,000 Kg. coal are needed. Figuring marks 2 for each 100 Kg. we get	2,140.	2,140	2,140.
6.	Lime for decomposing fixed ammonia compounds and binding carbonic acid. For each per cent. and weight, 12 Kg. good lime are used; one cubic meter gas liquor containing 1.8 per cent. NH_3 therefore needs 21 Kg. 100 Kg. lime are paid with marks 1.60; 6,300 Kg. then will cost	1,008.	1,008.	1,008.
7.	Cooling water. For cooling purposes almost four times the quantity of the gas liquor is used—12,000 cbm. 1 cbm. costing marks 0.05, we get	600.	600.	600.
8.	Cooling water for the ammonia compressor. About double the quantity of the gas liquor must be at disposition. Figuring 1 cbm. with marks 0.05=	.....	.....	300.
9.	Consumption of sodium hydrate. This depends a good deal on the carefulness of the operator. Usually ¼ Kg. is used for technical pure aqua ammonia and double the quantity for chemical pure aqua ammonia and anhydrous ammonia per cubic meter of gas liquor. We therefore need 1,500 resp. 3,000 Kg. of sodium hydrate. 100 Kg. of 75 per cent. NaOH cost about 22 marks; therefore 1,500 Kg.	330.	660.	660.
10.	Bone black filters. Bone black of pea size. In making technical pure aqua ammonia 1 Kg. bone black per cubic meter gas liquor is needed. For making chemical pure aqua ammonia and anhydrous ammonia, 2 Kg. are required. The price for 100 Kg. being marks 28, we have for 3,000 Kg.	840.	.....	.....
	" 6,000 Kg	.....	1,680.	1,680.
11.	Wages for laborers. The yearly production of 3,000 cbm. is worked up in 150 days. For each day (24 hours) 4 men are needed, each earning marks 4.50. In 150 days the total wages would be	2,700.	2,700.	2,700.
12.	Expenses for repairs and breakable parts	150.	150.	150.
13.	Expenses for packing material, waste and oil, illuminating of the working rooms, taking away the lime residuals, etc	450.	450.	450.
	Total Expenses	10,898.	12,068.	16,643.
	RECEIPTS.			
1.	3,000 cbm. gas liquor will yield 216 tons technical pure aqua ammonia, containing 25 per cent. NH_3 and a spec. gravity of 0.91. 1 ton is paid with marks 275, so we get	59,400.	.....	.....
2.	The same amount as above will be recovered as chemical pure aqua ammonia, paying 312 marks a ton, which would be	.....	67,392.	.....
3.	As anhydrous ammonia 54,000 Kg. can be produced, paying about 1.50 marks per Kg., amounting to	.....	.....	81,000.
4.	Deducting 3 per cent. for unavoidable loss on the ammonia	2,200.	2,200.	2,200.
	would give a total receipt of marks.	57,200.	65,192.	78,800.
	RECAPITULATION.			
1.	Total Receipts, marks	57,200.	65,192.	78,800.
2.	Total Expenses	10,898.	12,068.	16,643.
3.	Leaving a surplus of	46,302.	53,124.	62,157.
4.	Deducting the value of the gas liquor (1 Kg. NH_3=0.25 marks) with	13,500.	13,500.	13,500.
	Gives a net surplus of	32,802.	39,624.	48,657.

Residuals: Some History of.

[Prepared by MR. CARROLL MILLER, Pittsburg, Pa.]

This article will, in a general way, deal with residuals obtained in the manufacture of gas by processes classified as below:

1. Gas retorts.
2. Carburetted water gas.
3. By-product coke ovens.
4. Miscellaneous.

The residuals derived in the various types of apparatus used in making producer gas are not considered to be within the scope of this paper.

ONE.—GAS RETORTS.

Residuals—a. Coke.
b. Tar.
c. Ammonia.
d. Miscellaneous.

It would seem that the general character of these products has not changed to any great extent since 1860. On account of the benches being in recent years heated to a higher temperature the coke may be slightly harder than formerly, and the tar will contain a higher percentage of free carbon and a smaller quantity of light oils. The coke from vertical retorts is harder than that from horizontals and inclines, and the tar is similar in appearance to by-product coke oven tar.

a. *Coke.*—The average yield from a good gas coal is 65 to 70 per cent. by weight of the coal charged. Of this amount, 5 to 10 per cent. will be breeze; the percentage depending mainly on the methods of handling the coke. From 18 per cent. in a full depth recuperative bench, to over 35 per cent. in some direct fired retorts, of the coke produced will be used for fuel. It may here be of interest to note that in some localities, where natural gas is plentiful, it is found to be economical to use natural gas for firing the benches, thus leaving more coke for sale.

In the past, many companies have disposed of their coke at a comparatively small price, but, with the advent of water gas, which gives an outlet for a large percentage of coke made, and the creating of a demand for the product among domestic consumers, the majority of the gas companies now are able to get a fair price for their total output. Local conditions will determine the best methods to be adopted for selling and the sizes to which the coke should be broken; the smaller sizes and breeze, which are necessarily made, can usually be readily disposed of to blacksmiths and steel works.

b. *Tar.*—Quoting from "Coal Tar and Ammonia," by Lunge: "A sudden impetus was given to tar distilling in 1856, by the discovery of aniline colors, the material which forms their starting point, benzol, being exclusively derived from coal tar.

"In the centers of industry, where at the same time more gas is made, coal tar was at once converted from a nuisance into a com-

mercial article in great demand at good prices. Although only about one per cent. of the tar is obtained as benzol, this article at first yielded so much that the other products of tar-distilling could be sold at low rates and new markets could be opened out for them.

"In the course of time the following state of affairs has established itself. In England, where by far the largest quantity of gas tar is produced, where benzene was discovered by Faraday, its industrial preparations by Mansfield, the first aniline color by Perkin, and where the conditions are the most favorable for the purchase of the necessary chemicals as well as for the sale of the coloring matters, the manufacture of artificial dyes has only risen to moderate dimensions. The same has been the case in France. On the other hand, in Germany and Switzerland the manufacture of coal tar colors has been established on an enormous scale, so that the tar produced there formerly could only supply a small portion of the benzol and anthracene required, most of it being imported from England and France, partly in the form of aniline. . . . Hence in Germany and Switzerland, where the manufacture of coal tar dyes has reached its greatest development, it frequently happens that the tar produced at the gas works has to be burned under the retorts, a state of things which sometimes has partially, but from other causes mentioned before, arisen in Great Britain as well."

In this country the tar color industry has made but little or no progress.

Of all the residuals, the disposal of the tar appears to present the most difficult problem for the majority of gas companies, hence this subject is being dwelt on at some length. In foreign countries, refineries are installed at many gas works, where the quantity of tar produced is sufficient to warrant the cost of the installation. But few companies in this country have tar plants in connection with their gas works; but possibly local conditions will force them to it.

To illustrate what is sometimes necessary to meet local requirements, a few years ago a gas company was established in a large city in Japan, where there was but little demand for crude tar. Consequently a tar refining plant was built. The products produced were light oil, creosote, pitch and refined naphthalene, in the form of moth balls. Although the cost of the plant was very high, all the apparatus being imported from Germany and England, a handsome return was made on the investment; whereas, if the plant had not been installed, the tar would have been almost a total loss. The increasing use of tar for road-making, pitch for briquetting and creosote for preserving timber will doubtless make the market for tar better in the future.

In the process of distilling, the removal of the water from the tar consumes a large proportion of the total time of distillation. In England a process was recently devised for removing the water, after which the tar is distilled in the regular way. The driving off of the water is a continuous operation, and the foaming of the tar is prevented by keeping it under pressure. In a large plant in London, since this process was put into operation, a large number of the tar stills have been shut down.

Below are given some of the most common uses of crude coal tar and simple fractions of distillation.

Uses of Crude Tar.—

1. Paint.
2. Fuel.
3. Road making.
4. Preserving timber.
5. Manufacture of roofing felt.
6. Manufacture of lamp black.
7. Gas making.

Simple Fractions of Distillation.—

1. Ammoniacal liquor.
2. Light oil.
3. Middle oil.
4. Heavy oil.
5. Anthracene.
6. Pitch.

Product for Sale, from the Above.—

1. Ammoniacal liquor.
2. Light oil.
3. Creosote.
4. Naphthalene.
5. Pitch.

Uses of Products.—

Light Oil:

Illuminating.
Enriching gas.
Mixing with pitch to make varnishes.
Mixing with anthracene oil to prevent the absorption of illuminants when washing gas to remove naphthalene.
(Usually, however, light oil is rectified to make benzol and naphtha.)
Production of aniline.

Creosote:

Gas making.
Varnish making.
To soften hard pitch.
Antiseptic.
Preserving timber.

When carbolic acid is extracted from the middle oil, the residue is added to the creosote. Pyridine bases, which are used for denaturing alcohol, are obtained from the middle oil.

Naphthalene:

Color making.
Making "moth balls."
Burning for fuel and light.

Pitch:

Manufacturing of briquettes.
Making varnish.
Roofing.
Roofing felt.
Making asphalt.
Road making.
Making lamp black.
Making coke, gas, etc.

An ordinary retort house tar will yield, on distillation, per ton (2,240lbs.—about 220 gals.):

Ammoniacal liquor	5	gals.
Light oil	6	"
Creosote	61	"
Pure naphthalene	90	lbs.
Pitch	1350	"

The proportion of these products may vary considerably, according to the temperature at which the coal is carbonized, the character of the coal, etc.

c. *Ammonia.*—Gas coal ordinarily contains from one to two per cent of nitrogen, but much less than this amount is recovered in the form of ammonia. Five pounds of ammonia per ton of coal being considered a good yield from coal carbonized in horizontal retorts. The amount obtained from vertical retorts is said to run considerably higher.

Quoting from Lunge: "Since the great bulk of the ammonia compounds is obtained as a by-product in the manufacture of gas, and the latter is unlikely (?)—the interrogation point is mine—to be more extensively employed than it is at present, the question must necessarily arise: What will be the state of things if the demand for ammonia should exceed the supply? That emergency seemed inevitable at one time; and in consequence of this it was at once proved that a further enormous source of ammonia was present in the method of carbonizing coal which is practical in the production of coke for metallurgical purposes. The progress in this direction was not at first very rapid, owing to a sudden fall in the price of ammonia, which alone proved that the demand had not yet exceeded the supply. When such is the case, however, coke ovens will no doubt be generally reconstructed for the recovery of ammonia as well as of coal tar, which is always produced at the same time as the former. . . ."

In this country, recent prices of ammouia products would indicate that the supply by no means exceeds the demand. The increasing use of sulphate alone, for fertilizing purposes, would seem to give an outlet for a larger quantity of ammonia than is now being produced.

In former times gas liquor from the smaller works was ordinarily thrown away. Latterly, however, with the advent of cheaper and more efficient small concentrators, together with there being more chemical works throughout the country, even some of the smallest gas works can realize a profit by concentrating their ammonia. In some localities it will pay the smaller

works to manufacture sulphate of ammonia. The composition of ordinary ammoniacal liquor is:

Volatile, at Ordinary Temperatures:

Ammonium carbonate.
" sulphide.
" hydrosulphide.
" cyanide.
" acetate.

and possibly some free ammonia.

Fixed at Ordinary Temperature:

Ammonium sulphate.
" sulphite.
" thiosulphate.
" thiocarbonate.
" sulphocyanide.
" ferrocyanide.

"Fixed" means not removed by boiling. Lime is used to break up the fixed compounds.

The most common forms of ammonia are:

1. Liquor ammoniæ (caustic ammonia).
2. Anhydrous ammonia.
3. Sulphate of ammonia.
4. Ammonium chloride (sal-ammoniac).
5. Ammonium carbonate.

Principal uses of the foregoing:

1. Pharmaceutical purposes.
2. Refrigeration.
3. Fertilizing.
4. Soldering, galvanizing, etc.
5. Scouring wool, smelling salts, etc.

Crude ammoniacal liquor, as ordinarily produced at a gas works, contains about two per cent of ammonia. In the majority of cases, this liquor is concentrated to a strength of 15 to 20 per cent. and then shipped in tank cars.

Sulphate of ammonia is manufactured by some gas companies in this country, but this practice is much more common abroad.

The process of manufacturing sulphate is a very simple one. The liquor is passed through a still heated with steam, the fixed compounds being treated with lime. The vapors then pass to a saturator containing sulphuric acid; 60° B. acid is most commonly used. Here, the salt is formed and sinks to the bottom, from whence it is taken out continuously by mechanical means, or is allowed to remain in the vessel until the acid is neutralized, when all the salt is removed at once. There are a great many forms of stills and saturators, the description of which would take up too much space here.

d. *Miscellaneous.*—Carbon: Although the percentage of carbon made is small, it is a valuable product and well worth saving. There is a great demand for it from electric companies, which use it in the manufacture of electric lamps. The amount produced will vary with the type of retort and the methods of operating.

Sulphur: When the purifying material is discarded, the per centage of sulphur in it will often amount to 50 or 60 per cent. by weight. This material is commonly sold for a small sum or thrown away, when freight rates to the chemical factories are prohibitive. At some gas works in Europe the spent oxide is burned to make sulphuric acid, from which sulphate of ammonia is manufactured.

Cyanogen.—This product may be recovered from the gas by employing a special apparatus, similar to a rotary ammonia scrubber for washing the gas, which is treated in the scrubber with a solution of soda holding an iron salt in suspension. Ferrocyanide of sodium is formed.

Cyanides may also be recovered from spent oxide. The blue color appearing in the oxide is a mixture of cyanogen, iron and ammonia, which is crude Prussian Blue.

Below is given a list of the better known substances produced in the manufacture of coal gas and the utilization of the residuals:

Acetic acid.
Acetone.
Acetylene.
Alum.
Ammonia, anhydrous.
Ammonium acetate.
" bicarbonate.
" carbonate.
" chloride.
Ammonium cyanide.
" ferrocyanide.
" hydrate.
" sulphate.
" sulphide.
Aniline.
Anthracene.
Benzene.
Benzol.
Bitumen.
Carbon
Carbon dioxide.
Carbon disulphide.
Carbon monoxide.
Carbonic acid.
Coke.
Colors and dyes.
Creosote.
Creosol.
Cyanogen.
Ethane.
Ethylene.
Ethyl alcohol.
Fluorene.
Heptane.
Hexane.
Hydrogen.
Hydrogen sulphide.
Light oil.
Lysol.
Methane.
Methyl alcohol.
Naphtha.
Naphthalene.
Nitrogen.
Nitric acid.
Octane.
Oxygen.
Paraffin.
Pentane.
Phenol (carbolic acid).
Pitch.
Pyridene.
Pyrene.
Sulphur.
Sulphur dioxide.
Sulphuric acid.
Sulphurous acid.
Tar.
Toluene.

98.82

Two.—Carburetted Water Gas.

Tar.—This is the only residual obtained in the manufacture of water gas by the Lowe method. On account of the seeming impossibility, in former years, of successfully removing the water from this tar, it had but little value, and at many works it was considered a nuisance. However, at present, where there is no market for the tar, it can at least be used as a fuel. The process best adapted for separating the water from the tar is described in a paper read by Mr. A. S. Miller, at the meeting of the American Gas Light Association, held in October, 1896.

Some of the uses of crude tar:

1. Fuel.
2. Road making and dust laying.
3. Paint.
4. Making roofing felt.
5. Preserving timber.
6. Manufacture of lampblack.
7. Gas making.

Water gas tar is now being successfully distilled, and the products obtained have similar uses to those described under coal tar, although they are said, in the majority of cases, to be inferior. The United States Department of Agriculture has made, and is now making, some experiments in regard to the quality of the creosote. The use of tar in water gas generators appears to have met with but indifferent success.

In the method of making water gas with oil and steam only on the Pacific Coast, the by-product obtained is not tar, but lampblack, which is used for firing boilers.

104.3.

Three.—By-Product Coke Ovens

Residuals.—a. Gas.
b. Tar.
c. Ammonia.
d. Miscellaneous.

The introduction of by-product ovens in this country has not been rapid, and the history is by no means encouraging. The trouble appears to be, in some cases, due to the mismanagement of the installations and possibly also to poor construction and design, in addition to guarantees which were never fulfilled. These reasons, together with the increased cost when compared with beehive ovens, have apparently caused the majority of the coke men to proceed very slowly in adopting this form of oven. However, the success of other installations here, combined with some excellent results obtained in Europe, will probably eventually cause all the beehive ovens to be replaced by the by-product variety. The plentiful supply of natural gas in the Pittsburg district has been a large factor in preventing the steel companies in that vicinity from adopting the by-product process. In England and on the European continent, beehive ovens are seldom or never seen. At many coal mines in those countries the power required is supplied by gas engines, the gas being obtained from by-product ovens; there is but little smoke and dirt. The Connellsville region, in Pennsylvania, presents another aspect.

Figuring gas at 15 cents per 1000 cubic feet, which is the equivalent in heat units of natural gas at 25 cents, and tar and ammonia at current prices, the value of these residuals per net ton of coal, when carbonized in by-product coke ovens, will be about $1.30. The yearly amount of coal coked in the Connellsville region approximated 25,000,000 tons. As this total amount is

carbonized in beehive ovens, about $32,500,000 is thrown away each year in the form of smoke. If the tar were distilled, benzol extracted from the gas and sulphate of ammonia manufactured, the earnings would be greater. Necessarily, if all these products were suddenly thrown on the market, the prices could not be maintained, but probably, if by-product ovens were gradually to replace the beehive type, the demand would keep pace with the supply. Figuring the income from residuals at the above amount, the proceeds from their sale would be in the neighborhood of 50 per cent. per year on the total cost of a by-product coke oven plant.

a. *Gas.*—When the gas made during the earlier stage of carbonizing is kept separate from that produced later, the former is as good, both in illuminating and heating power, as gas ordinarily produced in retorts. The surplus gas from some types of ovens is considerably less than from others, but when the waste heat is utilized under boilers, the total surplus heat may amount to as much as that obtained in the form of coal gas from other ovens. Nevertheless, it is usually more desirable to obtain the larger amount of coal gas, as this product, in the majority of cases, can be used or disposed of to better advantage than hot flue gases, which must be used in close proximity to the ovens.

The uses of gas obtained from ovens are the same as those of retort gas. Very often, however, ovens are located in such places that the gas cannot readily be piped to large cities. Possibly, oven gas will eventually be pumped long distances, as is now the case with natural gas. In some localities, at the present time, oven gas is being transported several miles.

b. *Tar.*—Coke oven tar contains but little carbolic acid, and the percentage of pitch is usually smaller than in retort tar, otherwise the products are similar to those obtained from the latter.

c. *Ammonia.*—The amount of ammonia produced per ton of coal is usually greater in the case of ovens than in retorts.

d. *Miscellaneous.*—No carbon is recovered from ovens, but cyanogen and sulphur are produced, as described under "Gas Retorts." Benzol is usually extracted directly from the gas by scrubbing with anthracene or some similar oil.

As a general proposition, a gas company, contemplating the operation of by-product coke ovens, should consider the following points:

1. The disposal of the coke must be the primary object, and it is necessary to market this product uniformly.

2. The plant should be fully operated throughout the year.

3. If it is desired to supply the consumers with coke oven gas only, the plants must be of sufficient size to furnish the maximum daily demand, and the surplus gas on other days disposed of differently.

4. If all the coke oven gas is to be used for supplying consumers, the plant should be only of sufficient size to make not more than the minimum daily demand and the additional gas required supplied from other sources.

Great mistakes have been made by companies having installed coke ovens without first giving due consideration to the above conditions.

However, it is possible to heat the ovens with producer gas, thus leaving all the coal gas for other purposes. If it proved to be economical to adopt this method in any case, then the amount of coke produced in proportion to the coal gas would not exceed that made in retorts, although the candle and calorific power of the oven gas would be lower.

Four.—Miscellaneous.

Wood Distillation.—There are probably no towns now being supplied with gas made from wood, but some years ago such plants were in existence. Nevertheless, the distillation of wood, refuse particularly, is a large industry and well worth consideration.

There are many forms of apparatus used for distilling wood and for collecting and refining the products. Mr. Walter B. Harper ("Utilization of Wood Waste by Distillation") gives the following:

Amounts of Products Yielded per Cord of Wood.

Hard Woods.

Charcoal	40 to	50	bushels.
Alcohol (crude), containing acetone	8 to	12	gals.
Acetate of lime	150 to	200	lbs.
Tar	8 to	20	gals.

Resinous Woods.

Charcoal	25 to	40	bushels.
Alcohol (crude), containing acetone	2 to	4	gals.
Acetate of lime	50 to	100	lbs.
Tar	30 to	60	gals.
Wood oils	30 to	60	gals.
Turpentine, lightwood	12 to	25	gals.
Sawdust	2 to	10	gals.

Sawdust (Hardwood).

Charcoal	25 to	35	bushels.
Alcohol (crude), containing acetone	2 to	4	gals.
Acetate of lime	45 to	75	lbs.

Peat Distillation.—But few people seem to realize the enormous areas of peat deposits throughout this country. Up to the present but little use has been made of them. Several organizations, such as the American Peat Society, have been formed, with the object of promoting and demonstrating the use of peat and its products. These, together with better transportation facilities and improved machinery, will doubtless serve to bring peat more to the front.

Professor C. A. Davis has written a very complete work on "Peat" for the Geological Survey of Michigan. He says: "While peat has been commonly used for fuel in northern and western Europe from remote antiquity, and its use is still large and apparently increasing in Germany, Holland, Russia, Denmark and Sweden, it has not been brought to the attention of the people of Michigan until recently, that great quantities of this fairly efficient fuel exist within the boundaries of the State, as much as one-seventh of its entire area, or about 5,200,000 acres being estimated as swamp or muck land, although not all of this is underlain by peat."

From a plant in Germany, which has a capacity of 35,000 metric tons of theoretically dry peat per annum, the following products are said to be obtained from that amount of peat.

Peat coke	13,800	tons
Paraffine	230	"
Oils (heavy and light)	1,380	"
Sulphate of ammonia	184	"
Methyl, alcohol	92	"
Acetate of lime	270	"

The quantity of gas produced is not stated.

Prof. Davis says: ". . . A ton of peat by the Ziegler process only gives 6,650 cubic feet, which, considering that the peat has 20 to 25 per cent. moisture at the start, and costs, at the bog, a little less than one-third as much as the coal, really gives the peat the advantage, especially since the peat coke will command a much higher price than gas coke, on account of its freedom from sulphur and other objectionable matter."

Peat, when first removed from the bog, will contain as high as 85 to 90 per cent. of water.

Description of residuals obtained in the manufacture of gas by other processes than those mentioned herein have been omitted, as being of no particular interest to the gas profession generally.

Meters and Meter Makers.

[Prepared by Mr. Donald McDonald, Albany, N. Y.]

Much fun has been poked at the gas meter, and slurs innumerable have been cast at it. It has had little praise and much censure from the average citizen. This is rather curious, too; for, while the town clock is commended for telling the truth and reproached for being inaccurate, the gas meter, which averages to tell the truth oftener than the town clock, is seldom praised, and usually regarded with suspicion, if not actually arraigned for grand larceny. Perhaps there is a sordid motive in this, for the town clock tells only of the passing hours and costs nothing, while the meter tells of the passing gas, for which the consumer must pay, or sit in darkness. Is it only because the consumer must pay for what he gets that he says such things about the faithful recorder of his debt; if it is, is it not high time to stop saying such things?

This article has been prepared partly in the hope that, if it should fall beneath the glance of some who use gas, but do not sell it, such may be persuaded to think more gently of that which they have hitherto regarded only with frowns. In the main, however, it is addressed to those who have had more than a passing acquaintance with meters, past and present, who have

some acquaintance with the meter makers of to-day, and who may be interested in something about the meter makers of yesterday.

A few years ago a gas engineer of considerable prominence made the statement, at a meeting of one of the gas associations, that practically no progress had been made in fifty years in the art of meter making, and we were to-day using the same old meter that our grandfathers used. He made the statement, so he said, in the hope that the makers of meters would shake off the lethargy which had apparently settled over them, climb on the bandwagon of progress; and enlarge, improve, standardize and rationalize the old gas meter; affix a new nomenclature to the same; not forgetting to make the selling price of this product of progress less than the price that the long-suffering gas company had to pay at that time for its meters. This was rather a severe arraignment, and may fairly be said not to have been nor to be warranted by the facts. For, while experience has undoubtedly taught the meter maker to be conservative, yet in the main the meter has kept pace in real improvement with other branches of the gas industry. Moreover, it will be noticed that the engineer tacitly accepted the fact that the meter which the gas company was using was not at fault in principle, nor in quality, and that he had no thought of replacing the meter generally accepted as standard by a meter of another type; but he evidently hoped to induce the makers of the meter to make it in somewhat more accord with his ideas of how the meter should be made, and at the same time, enable him to purchase the same for less money. The fact thus tacitly accepted by the engineer, coupled with the fact that the meter then and still in use is essentially the same in principle as the meter used by the gas engineer when this paper issued its first number 50 years ago, is sufficient excuse for something in the way of a retrospective glance at its history and the history of the men who made it. Not that other forms and types have not been tried. Fearful and wonderful are the models that adorn the curiosity shelves of the meter shops and the Patent Office. Into these models seem to be incorporated every form of mechanical motion, and include meters wet and dry, inference meters—so-called guessers—and ready reckoners, round, square and other shapes, with every conceivable form of registering device, until it truly seems as if, in the meter business at least, there is nothing new under the sun.

But the hard thinkers of the beginnings of the gas business early evolved the principle that the only true way to measure gas was by the determination of its volume by actual measurement, and that to measure a given quantity of gas required a vessel whose cubical contents equalled that given quantity, and that no final satisfaction would result from attempting to ascertain the amount of gas passed in a certain time through a calibrated hole.

It may be of interest to note that fact that it was not until a reliable method of measurement was developed that the business of selling gas became profitable. At first gas was sold by contract, although always in hundreds or thousands of cubic feet, which amount was ascertained by the estimated number of feet per hour for each burner used. The gas company received payment for not more than 75 per cent. of the gas used and the business proved to be unprofitable; therefore, a means of ascertaining the exact amount used by each customer was diligently sought, and, when the meter was brought to such a state of perfection that it could be depended upon, the financial complexion of the business was changed.

It will not be necessary in this article to relate the history of the measurement of gas from its beginning in England, about 1815, when Clegg first began his experiments along this line; but it may be said that most of the early experiments were with meters of the wet type, and it was not until 1844 that a satisfactory dry meter was evolved.

The story of the evolution of the wet meter from Clegg's rotary holder to Crosley's revolving drum is one of the most interesting chapters of the early history of gas making. To quote what has already been said on the subject: "That Crosley's drum continued to be the standard for so many years is a further evidence of his inventive genius." The principles that he laid down have never been abandoned, and, although the form of his drum has been modified and the details of construction improved in every way, the wet meter drum, as he conceived it, continues in use as a consumer's meter where the climate is adapted to it; as a station meter for the correct measurement of gas as it is made at the works, and as an experimental meter for the accurate determination of the amount of gas used in photometrical and other philosophical work. So, while in spite of all efforts the wet meter has never been superseded as an accurate device for measuring gas, yet its use as a consumer's meter is limited by two conditions.

First.—As has been stated above, by the climate. Other fluids have been tried, but water is best adapted as a seal. Water cannot be depended upon to stay fluid in America, at least, where the temperature has a persistent habit of dropping below 32 degrees from November to April, necessitating a trip perhaps by paterfamilias in slippers and gown to the chilly cellar to thaw out the meter.

Second.—By the expense, for wet meters are comparatively expensive to manufacture per foot of measurement obtained. To which must be added also considerable expense for maintenance.

All of these factors led the English meter makers to consider some other type than the wet meter. The conditions that prevailed against the wet meter in England were emphasized in America; so we find that, soon after meters were made here in any quantity, the manufacture of dry meters was given the most serious consideration, and, with the assurance that a satisfactory meter of this type could be made, it soon superseded the wet type as a consumer's meter. At present, practically the only city in the United States in which wet meters are used to any extent, is in New Orleans, and there they are being abandoned as fast as is practicable.

The dry meter, in the form that we know it to-day, appears to be the invention of Mr. W. Richards. He patented it in England, in conjunction with Mr. Croll, in March, 1844. But the man whose name is most widely identified with the dry meter is that of Mr. Thomas Glover, the meter being generally referred to as the Glover two-diaphragm, slide valve meter. It is too well known to need any detailed description in this article. It may be said, however, that the mechanical principles used in this meter are not only sound, but the application is simple, and this is undoubtedly the reason why the meter has outlived other devices intended for the same purpose; but, if the application is simple, it does not imply that to make meters that will give satisfactory service is a simple matter. The successful manufacture of meters entails great care; the selection of the best materials, and, above all, eternal vigilance, which, like the price of liberty, is the price of good meters. This is no doubt true of any manufacturing business, but it is particularly true of the manufacture of meters.

The consumer's dry meter of to-day in America is substantially the meter of 1859 in England, but, like many other devices of similar character, the English meter of 1859, or, for that matter, of 1909, would find no market to-day in this country. The restless American is seldom satisfied with that which suited his grandfather, or, in mechanical devices, at least, with that which suits his English cousin; so the dry meter in this country soon began to take on a character of its own, and the years have brought many changes in details.

The advertising pages of this issue will direct those desiring it to more explicit information on the subject of how the meters of to-day are superior to those of 50 years ago, although the seeker for such information might be met by the statement by more than one veteran of the art, that the meters of to-day are no better than the meters of the '60s and '70s, and possibly, they are not, but it cannot be denied that they are better adaped to do the work they are now asked to do, and to meet the conditions that hold to-day in the selling of gas.

For one thing, much has been done in the way of uniformity in size and style. In this the gas associations have assisted materially, and particularly when they have entrusted the work to members who have been closely associated or actively connected with meter making. The American Gas Light Association took the first step in this direction by appointing a committee to investigate he subject of uniform meter connections. The work of this committee was admirably done, and within a few years after it made its final report, substantially every meter maker and every gas company had adopted the new standard. Since that time all of the old associations, and now the American Gas Institute, have interested themselves in the subject of meters in one way or another, and, upon the whole, to the benefit of all concerned.

About fifteen years ago a new device was introduced in connection with the meter which has produced perhaps as striking results as anything else since meters were made. This is the incorporation in or on the meter of a device allowing the consumer to pay in advance for his gas, or as it is commonly called, the prepayment meter. Like the meter itself, the idea originated, or was at least originally perfected, in England, and its use soon became popular. It is said that one of the largest gas companies in England had gained about 75,000 consumers in 30 or 40 years of corporate existence, but that in six years with the prepayment meter that number was practically doubled.

After the introduction of the prepayment meter in the United

States its use at first was rather slow, but the gas manager here soon realized that, especially in the congested districts, it was a business getter, and to-day, while no accurate figures are obtainable, it would be a good guess to say that one-third of the meters now being installed are of the prepayment type. And, why not? One of the insuperable objections in the mind of the thrifty householder to the use of gas is the bill of unknown amount coming in at the end of the month or quarter. With the prepayment meter this objection is removed at once. He, or oftener she, puts in the coin, and, if not satisfied, no more need be put in, and there is no bill to stare one in the face at the end of the month. On the other hand, the gas company usually finds it has gained that delight of the gas manager, the satisfied consumer, who proved to be, if not a large customer, at least a steady one.

Most of the English prepayment meters are operated with a penny, although many are now made for use with the shilling and other coins. The American makers followed this example and began the manufacture of the prepayment device adapted to a coin of small denomination. They soon found their way a difficult one. Our one-cent piece was too small and our nickel was not uniform enough in size to prove satisfactory. Moreover, as Mr. Dooley has expressed it, "Two drinks for a quarter is the standard of value," and the 25-cent piece soon came to be the standard coin of the prepayment meter.

Some mention should be made in passing of the effect on the meter business of the discovery of natural gas. When natural gas was first discovered in quantity, it seemed to be so plentiful, and so cheap, that there was no necessity of charging for it by the thousand feet, and the common method was to charge for the privilege of using the gas in unlimited quantities at so much a week or month. In a comparatively short time, however, this proved to be a very unsatisfactory arrangement, and the natural gas companies began to consider selling gas by meter. History repeated itself here, for, as stated before in this article, the artificial gas business proved to be unprofitable and unsatisfactory until the meter was introduced. A few of the oldest natural gas companies adopted the right course from the start, and that is to govern the gas down before it is delivered to the consumer, so that it can be used in the same kind of meter that is used for illuminating gas. A large number of companies, however, considered this a useless expense, and began to use meters which were said to be adapted to selling gas under high pressures, and many different types of meter were evolved in attempting to solve this problem. The best natural gas authorities concede to-day, however, that the meter that long ago proved its merit in the illuminating gas field is also the best adapted to the natural gas business.

As to how many meters have been made in the United States in the last 50 years, the writer has no guess to make. Those interested in statistics can tell you possibly how many gas consumers there are, and perhaps hazard a guess on how many meters have been condemned, but, as the sale of gas by meter is almost universal, it may be presumed that for every consumer to-day there is a meter.

The question is often asked, "What is the average life of a gas meter?" In Dr. Humphreys' masterly paper on "Depreciation," presented to the American Gas Institute in 1907, he appears to accept Professor Dicksee's estimate of 12 years; for in his modified tables he gives the number of times meters would need to be renewed in 100 years as 8.13. The writer has no desire to enter into any controversy on this point, but is inclined to think that 18 years would be nearer right, considering the average quality of dry meters used in this country. The following true incident related to the writer is rather interesting as bearing on this question. In a city in the western part of New York State, a meter was recently taken out which was installed in 1867, and which had been in continuous use, without repair, for 41 years. The gas company had often asked the consumer to allow them to replace the meter, but was met with the reply that the consumer's grandfather had originally purchased the meter, and, for sentiment's sake, if for nothing else, the consumer wished to retain it. The gas company finally insisted on their right to install a meter of their own, to which the consumer agreed, only stipulating that the gas should be measured by both meters. With the installation of the new meter the opportunity was taken of testing the old one, and, somewhat to the surprise of the gas company, the old meter proved to be correct. While this incident reflects great credit on the maker of the meter, it must be accepted, of course, as an extraordinary instance; but it is no doubt a fact that meters often average to measure more correctly when in undisturbed use than is indicated by the test on frequent removal. Theoretically this may be explained by the fact that the meter is at its best when performing the duty it was designed to do, and that is, to measure gas. The gas carries always more or less tarry products which are deposited on the diaphragm. When the meter is disconnected and the diaphragms are exposed to the air, the tarry products harden and stiffen the diaphragm, giving the meter a tendency to register fast. While, therefore, it is undoubtedly advisable for the gas company to pursue a policy of going over all their meters at certain periods, it is also advisable to leave the meter undisturbed, if possible, during these periods. But, says the gas manager, "How often should my meters be tested or overhauled?" This depends on several things. The quality of the gas; the general location of the works and the mains; and some meter makers might add, "On the make of meter which the gas company uses." The writer knows of some companies who go over their meters once every three years, taking one-third of the meters each year; of other companies who go over them once in five years, and regrets to say that he knows of companies who never seem to go over their meters at all, but leave them in until complaint is made. This last course has nothing to be said in its defense; for, although it must be admitted that some meters go fast, yet, in time, if the meters are neglected, they will finally all go slow, and the gas company will lose more through non-registration of gas than it would cost them to take the meters out occasionally and test them, repairing when necessary.

The Public Service Commission, with jurisdiction over the gas companies in the City of Greater New York, has recently promulgated an order that the gas companies in that city must test all their meters once every seven years. How they came to decide on seven is beyond the ken of the writer, unless they regard seven in the scriptural light of being a perfect number; but, as all the wisdom of oversight in such matters is presumed to be concentrated in the Public Service Commission, seven years must be accepted as the proper period.

As a matter of fact, the amount of work which the meter has done would be a better basis from which to judge its need of overhauling than the length of time that it had been in service, although possibly this course would not be practicable. The ideal service of a 5-light meter would be to have it measure—say, 250 feet—each day, which would give it a registration of 100,000 feet in about 13 months. If the gas company would examine the condition of a given number of such meters after period of registration of 100,000, 200,000 and 300,000 cubic feet, a better basis would be obtained from which to judge how long a meter should stand service without being overhauled, than to judge of its condition after periods of three, five or seven years of service. In discussing this question with a well-known meter maker, he stated that the above was undoubtedly true, and added, "Managers of gas companies often have, or appear to have, very curious ideas of the value of meters. The only true test of the intrinsic value of a meter must be based upon its demonstrated life of reliable active service. Not its weight nor its size, although these may be determining factors, but in the end the work it does determines its value."

Referring to the question of whether meters have a tendency to become fast or slow, it may be said that 25 years ago the sword of Damocles that was suspended over the head of the meter maker was the question of meters registering fast. Prior to this time the use of coal gas was almost universal. With the introduction of water gas came the introduction into the gas of all sorts of substances that boded no good to the faithful meter. The manufacturer found meters coming into his repair shop with diaphragms alternately tarred or water-soaked and collapsed. The general result was fast meters. He set about to meet the new condition as best he might. The best evidence of his success is in the fact that the question of fast meters is no longer a bugaboo. Of course, we know that the gas maker finally stopped experimenting and water gas became as perfect and fixed in character as coal gas, and with this perfection it ceased to have a detrimental effect on the meters.

In the course of seeking some information on which to base this article, the writer asked one of the most prominent meter manufacturers in this country if he had ever been asked to deliberately make meters that registered more gas than was actually measured. He stated that once only was he asked to make such a meter. He said that some years ago a comparatively well-to-do man bought a gas property in a small town. He sent for the meter manufacturer and said to him that, in order to get the franchise, he was obliged to concede such a low selling price for the gas that there was practically no money in it, so he wanted to know if he could not arrange with the meter manufacturer to get some meters that by registering, say, 20 per cent. more than was actually measured, would compensate him in some measure for the low price of the gas per thousand. It is needless to quote the answer given by the meter manufacturer. But, if the sense of this answer

were better understood, not only by the consumer generally, but by the solons of our legislatures who make the public service laws, and, coupled with the fact that, in the long experience of this manufacturer, this was the only instance when he was asked to make dishonest meters, it would, the writer believes, bring about a keener appreciation of how the seller of the gas has in the main tried to give his consumers an honest registration of the gas which he sells, and how the maker of the meter has tried to the best of his endeavor to put in the hands of the seller of the gas an instrument which would not only tell him how much gas he sold, and for how much the consumer was indebted to him, but also an instrument that would enable him to assure the customer that nothing in the way of the luxuries or necessaries of life was sold on a more equitable basis, conceding always of course that the price of gas per thousand is fair.

The status of the meter maker in the gas engineering profession in America has never been exactly defined. He has at times been thrown incontinently out of participation in the inner councils of those who considered themselves most skilled in the art of making and selling gas, because he was a seller of appliances, and then again he has been lifted to the highest post of honor in the associations of those interested in the art. He has been stopped and prevented from discussing, in the meetings of the various associations, the subject with which he was best acquainted, for fear that he would seize the opportunity to advertise his wares; and, then again, he has been begged and besought to contribute to the list of papers to be read before the same organization and applauded when he has presented the modest result of his efforts in this direction. Even more, when the admitted gas maker has for the time being donned the habiliments of the meter maker and conceived, elaborated and expounded at length on the merits of a new type of meter of uncertain value, he has been received with open arms and listened to with breathless interest for half a session. Seriously, however, the man who conducts a successful gas meter business must be much more than a meter maker. He must interest himself, to some extent at least, in all departments of the business of making and selling gas; he should have a clear understanding of the physical laws that underlie its manufacture and distribution, and be ready to apply his knowledge on demand. He will find himself appealed to from time-to-time to solve questions which have to do with the fundamentals of the art of gas making. His knowledge of the quality of gas that is being made is founded on an examination of the meters through which it is sold. It is in his station meter that the gas is measured before it finally passes to the holder where it may be drawn upon at will by the consumer. It is with his photometer, or his calorimeter, with its meter and other delicate appliances that the secrets of the business are disclosed. All these things bring him on to the most confidential relations with the manufacturing and distributing departments of the business, and it may be said to his credit that he has never disclosed this knowledge or abused the confidence reposed in him by his customers. If he has at times been accused of being overconservative and thus laid himself open to the charge, as stated in the first part of this article, of not being progressive, it is because he has felt that his position in the profession was at all times one of the utmost delicacy, and that it behooved him to cling closely to the traditions of the founders of the business.

The writer realizes the status of the meter maker in the gas engineering profession is one that has before now commanded the attention of wiser men than he, but it would seem as though the interests of the man who builds the works and makes the gas were so closely woven into the interests of the man who makes the meters that measure the gas, that the meter maker might be admitted without further discussion into that charmed circle of those who are known as active members; but, whether he is classed as an active member, or an associate member of the association, he surely is actively interested in the gas business. And, as we look over the names of the meter makers of the last 50 years, we find the names of men who have stood for all that is best in the gas business, and who have co-operated to the extent of their ability to place the selling of gas on a dignified basis and to make it worthy of the name of one of the applied sciences. It is a notable roll of names, and the men who bore them have had an important effect on the development of the gas business in this country. Under the guidance of these men the business of making meters has grown from an infant industry to one of the most important branches of the art. The writer hopes to present something of interest about these men. While the period assigned to him begins with 1859, yet he must go back of this a little in order to get a starting place for the story.

In the first issue of this JOURNAL of which this number is the semi-centenary, there appeared the advertisement of two firms of meter makers: that of Samuel Down, of New York, and of Code, Hopper & Gratz, of Philadelphia. In Mr. Down's advertisement appears the following paragraph, which, read in the light of today, has in it a considerable element of humor. After assuring his prospective customers of the high quality of the meters which he is now producing, he continues with these words: "He deems it highly necessary to place gas light companies throughout the Union, British Provinces, South America and Cuba, on their guard against all parties who are industriously endeavoring to introduce to their notice patent dry gas meters constructed precisely in imitation of his, but with Chinese-like characteristics, not fully understanding the correct principles upon which they are made." This rather flowery language would indicate that, even in 1859, there was considerable competition in the business.

As nearly as the writer can ascertain, meters were first made in this country in Baltimore. In a paper, contributed by H. C. Slaney, of Brooklyn, to the meeting of the American Gas Light Association, in Washington, in 1894, there is a very interesting account of the beginnings of this business. Mr. Slaney states that the first meter made in this country was made by Samuel Hill in Baltimore in 1832 and that the second meter was made in the same year by John Rodgers, a machinist of the same city, under the supervision of John M. Slaney, the elder. It would appear, however, that these meters were largely in the way of experiment. Mr. Slaney had learned something about making meters in London and came to the United States in 1829, settling in Philadelphia. The sample meter, or meters, which Mr. Rodgers had made, having met the approval of the officials of the Baltimore Gas Company, he secured from them an order for a thousand meters, but having practically no experience himself in the business, he sought Mr. Slaney and persuaded him to accept a position as Superintendent of a meter department in his shop, in which position Mr. Slaney continued for two years. In 1834, at the solicitation of James Mowton, Secretary of the Baltimore Gas Company, Mr. Slaney entered their employ as Superintendent of their meter shop and remained with them until 1849. John M. Slaney, Jr., was apprenticed to the Baltimore Gas Company in 1837, left their employ in 1839, but re-entering once more, continued with them until 1848, when he went into business for himself, forming a partnership with Charles Collier, under the name of Slaney & Collier, and opened a shop in Concord Street in Baltimore. This firm continued in business under this name until 1850. In the same year the elder Slaney, with his son and two others, organized the Phœnix Meter Company, and opened a shop at 44 Halliday Street. This company failed in the panic of 1859, apparently not from any fault in management nor because of the character of the goods they made, but on account of the depressed value of money and the difficulty in obtaining extensions. John M. Slaney, Sr., died in 1863, in the sixty-ninth year of his age. In the employ of the Phœnix Meter Company were two Englishmen, Thomas and Harry Tansley, clock-makers, and these men evidently made the movements or indexes for the Phœnix meters. It was through the connection of Thomas Tansley with the Slaneys that meter-making continued as an industry in Baltimore. Some years after the failure of the Phœnix Meter Co., Mr. Tansley associated himself with a fellow countryman, Edwin Baker, who had made meters in England, and afterward in Philadelphia, and they opened a small shop in Baltimore. Finding that they needed more capital, they advertised for the same in the daily papers. This advertisement was answered, among others, by Charles E. Dickey, a native of Baltimore, born in 1832, and up to this time actively engaged in the banking and brokerage business. Mr. Dickey consented to furnish the capital required, and the firm of Dickey, Baker & Co., was formed in 1866. Mr. Dickey became very much interested in his new venture, and continued to be actively identified with it until his death in 1905, taking the greatest pride in his connection with the work that grew up under his name. The firm continued in business under the same name until 1875 with the trade-mark "Maryland Meter" on their goods. In that year Mr. Baker sold out his interest to his partner, and the firm name was changed to Dickey, Tansley & Co. Mr. Tansley retired in 1883, selling his interest to Messrs. Charles E. Dickey, James B. Smallwood and Charles H. Dickey, but no change was made in the firm name. Mr. Smallwood remained with the firm until 1896, when he sold his interest to his partners. In 1902 the business was incorporated under the name of the Maryland Meter Co.

In the meantime meter-making had started in other cities. Mr. Slaney states in his paper that the first meter made in New York was made by C. Young in 1835. The writer is unable to

verify this, although it is probably true. But the name of the man most prominently connected with early meter-making in New York City is that of Samuel Down. Mr. Down was either born in Ireland, or in England, of Irish parentage. He was ingenious and shrewd, devoted to his family and his business, a pleasant associate, or as we would say in the vernacular of the day, a "good mixer." He came over from England to America and engaged in the manufacture of brass goods, and appears to have been intimately acquainted with the officers of the New York Gas Company and those of the Manhattan Gas Company. Both of these companies had a meter repair shop, and possibly made wet meters on a limited scale at their works for some years prior to 1836. Mr. Down furnished these companies with brass goods and with brass work for new and repaired meters. He had a good friend and close adviser in General Charles Roome, the then President of the Manhattan Gas Company, and it was he apparently who advised Mr. Down to go into the manufacture of gas meters and gas apparatus. As far as the records show, Mr. Down commenced business in 1836. He removed shortly to West 22d Street, where he carried on business for many years under his own name. The earliest records in his books that can be found show that he delivered twelve 5-light meters to the Brooklyn Gas Company, in March, 1851; but, as the maker's number of these meters was about 5,000, it would appear that he had manufactured about this number from the time he began in 1836 until the date mentioned (1851), and from which it may be judged that the production was limited, as it must necessarily have been, being almost all hand work.

In the late '60s Richard Merrifield came to New York from Albany, and through the influence of Joseph Sabbaton, who was the Engineer of the Manhattan Gas Company, associated himself with Mr. Down in the business of making meters under the name of Down & Merrifield, under which name they continued to manufacture both wet and dry meters for many years; in fact, until the combination of the firm with the Philadelphia meter-makers under the name of the American Meter Company.

There is a touch of romance in the story of the early meter-makers of the City of Brotherly Love. The writer could wish for more space in which to relate some of the details of this story, but the scope of this article forbids more than a sketch of the lives of the founders of the industry in this city.

Mr. Slaney states that, in the report of the Trustees of the Philadelphia Gas Works, in 1837, it is stated that in that year they were unable to obtain the necessary supply of meters of domestic manufacture, and so imported the number needed (343) from England, but in 1838, they reported that they had been able to obtain from a fellow citizen all the meters they required, highly satisfactory in quality and equal to imported. These meters were undoubtedly made by the firm of Colton & Code. Owen Colton was a brother-in-law of Baldwin of locomotive fame, and a manufacturer of Britanniaware, with a place of business in Library street. It was here that he began the manufacture of wet meters. Theophilus P. Code first obtained a knowledge of meter making in the meter shop of Messrs. Clegg & Crosley, in London. Knowing that meters were being exported to America, Mr. Code concluded that, if there was a market there for meters, it would be a good place to manufacture them. He, therefore, came over to New York, and, after making some inquiries, was offered employment by the Manhattan Gas Company. He was a man of strong character and enterprising disposition, however, and, as his object in coming to this country was to get into business for himself, he did not take the proffered employment, although, possibly, he worked for the gas company a short time. Learning that a new gas works was being built in Philadelphia, he went over there and called on John C. Cresson, engineer of this works. He also went down to Baltimore and visited Mr. Slaney, with whom he was acquainted. Returning to Philadelphia, he inquired of Mr. Cresson as to the prospects of establishing a shop for making meters in Philadelphia. Mr. Cresson informed him that Mr. Colton was already making meters to a limited extent, and that, in his opinion, it would be folly for another man to go into this business, as there was certainly not enough business for both. Mr. Code was not discouraged by this, but, procuring an ingot of metal, took it over to Mannyunk and got it rolled so he could make it into meter drums. He formed an acquaintance with a man named Matsinger, who appears to have been in the blacksmithing business. In Mr. Matsinger's place Mr. Code made a 3-light meter which he took to Mr. Cresson. Through this interview with Mr. Cresson, he became acquainted with Mr. Colton, with the result that Messrs Colton & Code went into partnership and started a shop on the corner now occupied by the Masonic Temple, but later removed to a place on Jones street, near Fifteenth. Through the influence of Mr. Code, William Hopper became associated with the firm and the name was changed: First, to Code & Hopper, possibly on account of the death of Mr. Colton, which occurred about this time, and, afterward, to Code, Hopper & Co. Both Mr. Code and Mr. Hopper returned to England, and, about 1859, the active management of the firm developed on Messrs. Thomas E. Hopper and Robert H. Gratz, and, shortly afterward, the firm name was changed to Code, Hopper & Gratz. This relation continued but a short time, and, by 1862, the firm had dissolved and two firms were established under the names of Robert H. Gratz & Co., and Code, Hopper & Co., with Henry Cartwright as one of the partners of the latter firm.

The condition of business at this time with the country plunged in war was most distressing, and the meter business was no exception to the rule. Prices of metals, and of everything needed in manufacturing, advanced tremendously. The gas business was in a particularly depressed state, and the gas companies had not sufficient confidence to make any extensions. The meter business, which had apparently made such a prosperous beginning, seemed doomed to failure. About this time Mr. Cartwright made the acquaintance of Messrs. Down & Merrifield, of New York. After consulting with Mr. Hopper, they conceived the idea of uniting the three struggling firms in these two cities under one head. They represented the advantages of this move so well to their associates that, n 1863, the American Meter Company was formed, with Samuel Down as its president, and with a factory in both New York and Philadelphia.

About 1879, Wm. N. Milsted, whose father was in the employ of Code, Hopper & Co., was made Superintendent of the New York factory, and he still continues as its Manager, while the management of the Philadelphia factory has passed to Mr. Cartwright's son, Henry R. Cartwright.

Washington Harris commenced the manufacture of wet meters in Philadelphia, in 1848, in the shop of Harris & Garner, on Ninth Street above Market. Mr. Harris had the reputation of being an enterprising and very good business man and made a considerable fortune. It was said of him that he was the first to introduce heating furnaces into dwelling houses in Philadelphia, and it is probable they were the first in use anywhere. After a time the firm of Harris & Garner was dissolved and Mr. Harris first took his brother Andrew into partnership, and, afterwards, his brother J. Wesley Harris, the firm name being changed to Harris & Brother. Mr. Harris obtained a knowledge of the manufacture of dry meters from Thomas Glover, who visited this country about 1860, and the manufacture of wet meters in any quantity was soon discontiued. After a short time Andrew Harris left the concern and his place was taken by Dr. Wm. H. McFadden, who remained in the business until he was elected Chief Engineer of the Philadelphia Water Works by the City Councils of Philadelphia. The next partner in the concern was William Wallace Goodwin, who remained with the firm for some time and sold his interests in 1872 to William Helme. In 1876 John McIlhenny bought the interests of J. Wesley Harris and the firm name was changed to Harris, Helme & McIlhenny. This title continued until 1885, when Washington Harris withdrew on account of advancing years, selling his interests to his partners, his place being taken in the concern by Mr. Helme's son, William E. Helme, and the firm name was changed to Helme & McIlhenny. Upon the death of the elder Helme, William E. Helme succeeded to his father's interests in the firm. The long and intimate relation of both William Helme and John McIlhenny with the gas and meter business deserves more than a passing mention in this article.

While yet a young man Mr. Helme left the Baldwin Locomotive Works to accept the position of Superintendent of the Trenton (N. J.) Gas Works. Shortly afterwards he accepted a position with Messrs. Perdicaris & Hoy, who were at that time the most active and extensive gas works builders in this country. For them Mr. Helme built the works at Augusta, Ga., and, jointly with John P. Kennedy, late President of the Mutual Gas Light Co. of New York, completed the works in Portsmouth, Va., and Alexandria, Va. Mr. Helme afterwards built on his own account the works at Winchester, Va., Bellefonte, Pa., and Atlanta, Ga. He was one of the distinguished few who met by appointment in New York City to consider weighty problems affecting the gas interests, and out of which meeting grew the American Gas Light Association. Mr. Helme was marked as a man of benevolent and charitable spirit and took an active interest in several organizations of this character in Philadelphia. He was twice President of the St. Andrew's Society of Philadelphia, and, at the time of his

death, a Director of the Franklin Institute and of the Hayes Mechanics Home.

Mr. Helme's partner, John McIlhenny, served an apprenticeship at meter making with the firm of Colton & Code. Leaving this concern he spent a short time under the instruction of John C. Cresson, Engineer of the Philadelphia Gas Works; after which he entered the employ of Messrs. Perdicaris & Hoy, and superintended for them the building of a rosin gas works at Wilmington, N. C., and remained with the Wilmington Company for nearly five years as Superintendent of the works, when, at the request of Messrs. Perdicaris & Hoy, he went to Columbus, Ga., to rebuild the gas works and remained there as Superintendent for twenty years. Five of these years he was a member of the Board of Aldermen and afterwards served five terms as Mayor of the City. While interested in the City Government of Columbus, he was largely instrumental in establishing the splendid system of public schools now in that city, and, during the remainder of his residence there, was a member of the Board of Education. Returning to Philadelphia in 1876, he engaged in the meter business, as related above, and has since continued in it. Of the most kindly disposition and engaging personality, the writer is sure that no one will find fault when he styles Mr. McIlhenny the Dean of living meter makers in America.

Returning again to a period shortly after the Civil War we find that Andrew Harris, after withdrawing from Harris & Brother, again engaged in the meter business, and, in 1869, he formed a partnership with John J. Griffin of New York City, under the firm name of Harris & Co. Mr. Griffin, who prided himself on tracing his ancestry back to sturdy Knickerbocker stock, was born in New York City, in 1829. While still a youngster he entered the employ of the Novelty Iron Works as a machinist. He associated himself with his brother-in-law, W. D. Reynolds, the introducer of Belgian block as a city pavement, and, under Mr. Griffin's supervision, Sixth and Eighth Avenues were paved with this material. In 1859 his attention was directed to the gas business, and, having always been interested in mechanics, he took up the manufacture of meters, organized the firm of John J. Griffin & Co., and opened a shop at Thirty-seventh Street, near Sixth Avenue. Making the acquaintance of Mr. Harris, he removed his business to Philadelphia, and consolidated it with that of Harris & Co., and, in 1871, the firm name was changed to Harris, Griffin & Co., with the factory located at Twelfth and Brown Streets, Philadelphia. Andrew Harris died about 1880, and, in 1890, the firm of Harris, Griffin & Co. was dissolved, and the firm returned to the original name, that of John J. Griffin & Co., with John Gribbel as the junior partner. Mr. Griffin died October 22, 1892.

Few gas men visiting Philadelphia in the 25 years succeeding the Centennial failed to call at the well-appointed offices of the meter factory in Filbert Street, and pay their respects to the presiding genius of the establishment, William Wallace Goodwin. Born in Wethersfield, Conn., in April, 1833, Mr. Goodwin entered the employ of Hopkins & Company at the age of 12. His family removed from his birthplace, first to New York, and afterwards to Philadelphia. In 1850, his father became the Superintendent of one of the Philadelphia gas works and appointed young Goodwin his assistant. At the age of 21 he entered the employ of William E. Parrish, who was a gas works builder. Through this connection he became Superintendent of the gas company at Selma, Ala. When the Civil War broke out, he resigned his position and entered the United States Navy as Assistant Paymaster. After the war he engaged for a short time in the oil business and, later, became a meter maker by entering the firm of Harris & Brother. He sold his interest in the firm, and, about 1872, organized the firm of W. W. Goodwin & Co., which, later, became the Goodwin Gas Stove & Meter Co. Mr. Goodwin was one of the enthusiasts, not only of the meter business, but of the gas fraternity. He varied the tedium of meter making by excursions into the various fields of gas activities. He was a strong believer in the Clerk gas engine which failed, however, to succeed in competition with the famous Otto. He gave much of his attention to producing new and handsome forms of experimental and philosophical gas apparatus. He devoted a good deal of time and money to a gas stove department in his business. He was a familiar figure at all of the Gas Association meetings and a frequent contributor on a variety of subjects to its literature. Industrious and ingenious, kind-hearted and genial, he failed in the main issue, that of establishing his business on a permanent basis. In addition to his business troubles, his health failed him and he died in 1901.

Practical meter making appears to have been established as an industry at both ends of the historic Boston and Albany road at about the same time, although there was evidently no connection between the meter makers of Boston, the Capital City of New England, and the sturdy Scotchman who began making meters in that City at the other end of this road, now often called the Gateway of the West.

The Boston Meter Works was organized in 1849, having for its President, the then President of the Boston Gas Light Co., Mr. Darracutt. They manufactured at first wet meters, and after a while began the manufacture of dry meters at the old North End Gas Works on Commercial Street. This business does not appear, however, to have been a success, for, in 1857, the Company failed and went out of business. Nathaniel Tufts was practically the pioneer meter manufacturer of New England. He was born in Malden, Mass., in 1825, and came from sturdy Puritanical stock. He went to work for the Boston Meter Works in 1849, first as a workman and later as a foreman. In 1860 Mr. Tufts, in company with his brother Augustus Tufts, and a man named Cheever, formed the Tufts-Cheever Company, to conduct what appears to have been a somewhat general business. Nathaniel Tufts attended to the making of meters, Augustus Tufts gave his attention to the making of lanterns, and Mr. Cheever was more particularly interested in making a churn which he had patented. This partnership continued until 1862, when the Messrs. Tufts bought out Mr. Cheever and continued the business, under the name of Tufts Brothers, manufacturing meters and also ship, railroad and street lanterns. In 1878 Nathaniel Tufts took over the entire business and operated it under his own name until 1890, in which year he died. The business was continued under the same name and, for a time, under the management of C. W. Hinman, formerly Inspector of Gas and Meters for the State of Massachusetts, and the inventor of the well-known station meter drum. Mr. Hinman afterwards organized the firm of C. W. Hinman & Co., manufacturing meters and other specialties of his own design. This company was afterwards absorbed by the Nathaniel Tufts Meter Co., which was organized in 1896.

Traveling westward on the old Boston Road in the year 1855, we would have found a little meter shop at 51 Lancaster Street in the fine old City of Albany. For some years prior to this date Donald McDonald, who was born near Inverness, Scotland, in 1809, had been following his trade of master mason, and had built up a considerable business. Mr. McDonald had a turn for mechanics, however, and at times amused himself with the repairing and occasionally the making of clocks, so that, when his brother Hugh came over from Scotland, he was the more easily persuaded to abandon the business in which he was engaged and go into the business of making wet meters, and this business was commenced at No. 51 Lancaster Street, in 1855, under the name of D. & H. McDonald. The wet meter business, however, proved not much of a success; probably the northwest winds that swept down through the Mohawk Valley had in them too many degrees of frost to allow the wide-spread use of wet meters in that vicinity. Hugh McDonald returned to Scotland and remained there, preferring the "cauld blasts frae the Hielan' Hills" to the cold reception with which his business ventures had been received in America. Donald McDonald was somewhat discouraged with his experience in meter making, but, believing there was a future to the business, if the right kind of meter could be furnished, investigated the subject of dry meters, which were then being made to a limited extent. To obtain further information along this line he made a voyage to England. Returning to Albany, he formed a partnership with Noel E. Sisson, in 1858, under the name of D. McDonald & Co. The manufacture of "Wets" as consumers meters was abandoned, and the making of dry meters, of the Glover type, was begun in earnest. Mr. McDonald retired from active participation in the business in 1885. He died in 1892. Mr. Sisson retired in 1896 and died in 1904. Upon the retirement of the elder McDonald, his interest in the business passed to his son, William McDonald, who had been associated with his father as a meter maker since 1860.

This ends the list of the meter factories and men who were identified with the business from the beginning and during the period ending in more recent days.

For obvious reasons it seems inadvisable to mention the meter makers of to-day, except as they are identified with the older houses. The younger men of the business, with whom the writer is proud to class himself, may well study the lives of those who founded the industry, and, should they succeed in any degree to the stature of those whose names are found in this chronicle, they will be well deserving of more than a passing mention at the hands of him who shall write a like article for the Centenary Issue of this JOURNAL, in 1959.

In conclusion. It has been truly said that man is largely the product of his environment. The keynote of meter making is truth. A meter that does not tell the truth, that is not essentially accurate, is worthless as a meter. The man who undertakes the making of meters must be honest to succeed, for his character will be reflected in his work. This is not to say that all the men who have attempted the business of making meters in this country have been marked especially for their strict integrity; but, if such have taken up this work, either one of two things has happened; the character of the man in respect to his honesty has improved, or his business has proved a failure.

Progress in Electric Current Development in the Artificial Lighting Field.

[Prepared by ALBERT F. GANZ, M.E., Professor of Electrical Engineering, Stevens Institute of Technology.]

One hundred years ago Sir Humphry Davy exhibited the first voltaic arc before the Royal Institution of London, and this may be said to mark the birth of the electric light. This Davy arc was produced between wood-charcoal electrodes, by means of a powerful voltaic battery of copper-zinc cells, and was at best a brilliant lecture-room experiment. Subsequently he enclosed the electrodes in a glass vessel, from which the air was exhausted to prevent combustion of the charcoal points. No attempts to use the electric arc as a source of light was made, however, until about 1844, when a French physicist, by name of Foucault, produced an arc between electrodes made of gas retort carbons by means of a large Bunsen battery. Foucault produced a remarkably steady and continuous arc light, which he exhibited publicly in Paris, and, indeed, used this arc light for lighting the stage of the Paris Opera House during a performance of the opera, and for lighting a number of public squares in Paris. This is the first time that the possibility of using electric light for lighting houses and streets began to be considered. The expense and trouble involved with the use of batteries, as well as the necessity of controlling the lamps by hand, soon discouraged any attempt to use the Foucault arc lamp for commercial lighting. In 1845 Thomas Wright, of London, produced the first arc lamp in which the carbons were automatically regulated, the carbons being in the form of disks, which were slowly rotated by clock-work. This was followed by the development of various types of regulating mechanisms, by many investigators in Europe and in America, who used various devices for striking the arc and feeding the carbons as they were consumed.

In 1831 Michael Faraday discovered the principle of electromagnetic induction, and this discovery was followed by the invention of early forms of magnete-electric machines. These machines made it possible to obtain powerful currents in a simpler and cheaper manner than was previously possible with batteries, and a number of attempts were made to employ such machines for arc lighting. One of the first important applications was made in 1858 by the Lighthouse Department of England. This department, under the direction of Faraday, successfully introduced the electric light in its important lighthouse at South Foreland, employing the Alliance dynamo, devised by Nollet and Van Malderen, of Belgium. It is an interesting historical fact that the Alliance dynamo thus employed for supplying current to an electric arc light was built originally for the purpose of decomposing water, in order to employ the resulting gases to produce a powerful lime light.

In 1876 Jablochkoff brought out his celebrated electric candle, and obtained patents for this all over the world. The Jablochkoff candle was marked by the absence of any regulating mechanism. It consisted, broadly, of two vertical sticks of carbon separated slightly by an insulating material, such as kaolin, which was consumed at the same time as the carbons. These lamps were found to burn best with alternating current, which insured an even consumption of the carbons. They were soon to be seen burning on the streets of European cities, and found popularity in the United States as well, one of the first places in this country in which they were employed being the store of John Wanamaker, in Philadelphia. While a number of these Jablochkoff candle installations were made they were actually used for a comparatively short time only.

The introduction of the Gramme dynamo-machine in 1871, marked a new era in electric lighting on both sides of the Atlantic, and inventors began to develop direct-current dynamo machines and arc lamps operated by these machines. Prominent among the early American inventors in this field may be mentioned Weston, Brush, Thomson, Houston, Wallace, Farmer, Wood, Hochhausen and others. During the following ten years a number of direct-current dynamo machines were developed for supplying current to arc lamps. These machines were designed to supply at first a single lamp,, while later machines were made to supply as many as 50 lamps in series. Lamps employing two pairs of carbons were also introduced, so that when one pair became consumed the other would be automatically cut in, thus continuing the lamp in operation until both sets of carbons were consumed and so reducing the labor of trimming.

It is interesting to note that, in 1876, at the Philadelphia Centennial Exposition, a portion of the Exposition buildings and grounds was illuminated by a few electric arc lamps supplied from a Wallace-Farmer dynamo-electric machine.

One of the earliest attempts to utilize a wire heated to incandescence by an electric current as a source of light was made by Grove, the inventor of the battery which bears his name, and is described in the "Philosophical Magazine" for 1840. Grove's lamp was, of course, of very crude form, consisting of a spiral of platinum wire attached to two copper supports and enclosed in a cylindrical glass jar inverted in a shallow dish of water. Grove states in his paper that he succeeded in reading for many hours by the aid of this lamp. In 1841 De Moleyns, of England, patented an incandescent lamp which consisted of a platinum wire enclosed in an exhausted bulb and rendered incandescent by an electric current. A few years later, Starr, of Cincinnati, devised a lamp in which a thin strip of graphite, connected to two conducting wires of platinum, was suspended in an exhausted glass globe and rendered incandescent by an electric current. This lamp involved in fact the essential elements of the carbon filament lamp of to-day. No practical lamp resulted, however, from these early experiments.

About 1875 a number of investigators set their energies to the development of a commercial incandescent lamp, and produced some practical lamps, but these lamps were not introduced in actual practice until about 1880. Prominent among the workers in this field at this time were Weston, Sawyer, Man, Edison, Maxim and others.

By the year 1880 a number of direct-current dynamos had also been developed for supplying incandescent lamps in multiple at constant voltage. The great interest which had developed by this time in the electrical industries gave rise to the first International Electrical Exposition, which was held in Paris in 1881. At this Exposition most of the prominent inventors and manufacturers in the electrical fields of the world exhibited their inventions and products. A good description of this Exposition is found in a Government Report, made by Major David Porter Heap, of the Corps of Engineers, United States Army, and published by the Engineer Department, United States Army, in 1884. A very complete history of electric illumination from the earliest beginnings to the year 1881 is also found in a large work by James Dredge, entitled "Electric Illumination" and published in 1882 by John Wiley & Sons, of London and New York.

From this time to the present the development in the electric lighting field has been enormous. This progress has been well recorded by Mr. T. Commerford Martin, in the Annual Reports of the Committee on Progress of the National Electric Light Association. The development, up to 1902, is also well set forth in the Special United States Census Report, on Central Electric Light and Power Stations, issued in 1905 by the Department of Commerce and Labor. Some of the data contained in the following has been obtained from the above reports. Electric lamps have been developed along three distinct lines, namely, arc lamps, incandescent lamps and vapor lamps. The progress since 1880 is conveniently considered under the separate headings of "Development of Arc Lamps," "Development of Incandescent Lamps," "Development of Vapor Lamps," and "Development of Machinery and of Systems of Distribution."

Development of Arc Lamps.—The series direct-current open arc lamp was the most generally used arc light for street illumination up to the late nineties, and quite a number of these are, in fact, still in use. These open arc lamps operate generally with a short arc taking from 40 to 50 volts. The upper carbon is made the positive electrode, and practically all of the light comes from the incandescent crater of this positive carbon, the arc itself being non-luminous; the greatest intensity of light is projected at an angle of about 45 degrees downward. These open arc lamps were developed in two sizes, the larger size taking 9.6 amperes, or about 450 watts, and formerly known as the normal 2,000 candle power

lamp or "full-arc", and the smaller size taking 6.6 amperes, or about 325 watts, and formerly known as the normal 1,200 candle power lamp or "half-arc". This does not mean, however, that these lamps actually give a light of 2,000 and 1,200 candles respectively, but these ratings have become trade names. Dr. Bell states that the 9.6-ampere lamp gives about 1,200 candles in the direction of maximum intensity, and a mean lower hemispherical candle power of about 600; and that the 6.6-ampere lamp gives about 700 candles in the direction of maximum intensity and a mean lower hemispherical candle power of about 350.

For a time the size of an electric arc lamp was expressed in terms of watts consumed in the arc, and specifications for street lighting were frequently drawn up on this basis. With the introduction of enclosed and flaming types of arc lamps this method was necessarily abandoned. The present practice is to express the light intensity in mean spherical candle power and the specific power consumption in watts per mean spherical candle. This specific power consumption is frequently called the efficiency of a lamp, but it is actually the reciprocal of efficiency. Special integrating photometers have, in fact, been devised whereby mean spherical candle power can be quickly determined from a single photometer setting. In some cases mean lower, hemispherical candle power is measured and the specific consumption is expressed in terms of watts per mean lower hemispherical candle. This is frequently done in the case of lamps which are so designed as to project all of the light into the lower hemisphere.

Series arc lamps operating on constant-alternating current circuits have also been introduced, especially since the constant-current transformer was developed in 1902. In the alternating current arc each carbon becomes alternately positive and negative, and the reversals of current must be sufficiently rapid so that the arc is not extinguished between reversals and that there are no disagreeable fluctuations. This condition necessitates a frequency of at least 40 cycles per second, and in practice a frequency of 60 cycles or 120 alternations per second is most frequently employed. Owing to the fact that the light is emitted from the incandescent tips of both carbons the light is distributed equally in the upper as well as in the lower hemisphere. An alternating current arc lamp also gives very much less total light than a direct current arc lamp consuming the same number of watts.

In 1893 Mr. Louis B. Marks described the enclosed type of arc lamp, in a paper presented at the International Electrical Congress, held in Chicago in that year. The enclosed arc lamp quickly met with favor in America and soon began to supersede the open arc lamp. In the enclosed type of arc lamp the arc is surrounded by a small globe of refractory glass, in the bottom of which is fastened the lower carbon and through the top of which the upper carbon moves freely in a stuffing-box arrangement. By this means access of air to the arc is restricted and the enclosure quickly fills with heated gases with the result that the arc takes from 70 to 80 volts with a reduced current and the carbons burn away much more slowly than with the open arc. The gases enclosed in the inner globe are heated to incandescence in the vicinity of the arc, so that the entire interior of the globe appears to be incandescent, thus giving a very much better distribution of light than with the open arc. The total quantity of light emitted from an enclosed arc lamp is very much less, however, than that emitted from an open arc lamp taking the same number of watts; but, owing to the more uniform distribution of the light, a better general illumination is produced and the color of the light is also more nearly white. A pair of carbons will last about 100 hours in an enclosed arc lamp, but only from 5 to 10 hours in an open arc lamp; there is, therefore, a great saving in carbons and in labor of trimming, with the enclosed arc lamp over the open arc lamp. This is the principal reason why the enclosed arc has almost entirely superseded the open arc in America. In Europe, where carbons and labor are cheaper, the enclosed arc has not met with favor, because of its much lower light efficiency. Enclosed arc lamps are used both for street lighting and for interior lighting of shops and stores, for which latter class of lighting the whiteness and uniform distribution of the light makes them preferable to open arc lamps.

The electric arc lamp is inherently a constant current device, because the electric arc has the characteristic of decreasing in potential difference with an increase of current. The early arc lamps were, therefore, constructed to operate in series from constant current dynamo machines, thus requiring a high line voltage, which was permissible for street lighting for which such lamps were exclusively used. In the beginning of the nineties arc lamps began to be constructed to operate on constant potential circuits with incandescent lamps. For indoor lighting by arc lamps the constant potential enclosed type of lamp is now almost exclusively used. An arc lamp, in order to operate on a constant potential circuit, requires the addition of sufficient resistance in series with the arc, so that to increase the current it is necessary to increase the voltage. For this reason constant potential arc lamps are necessarily less efficient than constant current arc lamps, and this decrease in efficiency amounts to about 30 per cent. in a direct current lamp. In a constant potential, alternating current arc lamp the loss in power is less, because a reactance is used instead of a resistance, but the power factor of the lamp is greatly lowered.

The relative specific power consumption of various types of carbon arc lamps of average size are given by Dr. Bell as follows:

Type of arc.		Watts per mean spherical candle.	Remarks
Direct current, open	Series lamp.	1.0	Medium power arc.
Direct current, shaded	" "	1.3	Medium power arc.
Direct current, enclosed	" "	1.9	Approximate.
Alternating current, open	" "	1.7	Approximate.
Alternating current, shaded	" "	2.2	Approximate.
Direct current, enclosed	Multiple lamp.	2.4	No outer globe.
Direct current, enclosed	" "	2.9	Clear outer globe.
Direct current, enclosed	" "	3.3	Opal outer globe.
Alternating current, enclosed	" "	3.0	Clear outer globe.
Alternating current, enclosed	" "	3.6	Opal outer globe.
Alternating current, enclosed	" "	2.5	No outer globe.

During the latter part of the nineties a type of arc lamp was introduced, by Bremer in Germany and by Blondel in France, in which metallic salts, principally salts of calcium, were added to the carbons. In the operation of the lamp the metallic salt is vaporized and rendered incandescent, thus producing an arc which is highly luminous and of an orange-yellow color when calcium salts are used. These new lamps are called flaming arc lamps.

Two distinct types of flaming carbon arc lamps have been developed. In the first type, due to Bremer, the carbons converge downwardly, the arc forming between the bottom tips of the carbons, a blowing magnet placed above the arc sometimes being used to project the arc downward, thus preventing the arc from climbing up on the carbons. This produces a long arc and gives a downward distribution of the light. In the lamp, as brought out by Bremer, the material of the carbons was mixed with salts of the calcium group. This type of lamp, with downwardly converging mineralized carbons, has been adopted by a number of manufacturers and is largely used. In the second type of flaming carbon arc lamp, due to Blondel, the carbons are placed in a vertical line one over the other, as in an ordinary arc lamp. This results in more light being projected in a horizontal direction and, therefore, gives a better distribution of light than is obtained with the first type of lamp. The electrodes are made of pure carbon provided with a core containing the minerals to be vaporized in the lamp.

Besides calcium compounds, titanium compounds have also been used, giving the arc a white color. The titanium arc is, however, not as efficient a light giver as the calcium arc. The effect of adding calcium or titanium salts to the carbons is, however, to produce fumes which prevent the enclosing of the arc in a small glass chamber. These flaming arcs must, therefore, burn in the open air with the result that the carbons have a short life and require frequent trimming. These flaming arc lamps have been very largely used for street lighting in Europe since 1900. During the past five years such flaming arc lamps have also been introduced in America; they are not generally used here for street lighting, however, but rather for lighting the fronts of shops, theatres, etc., for advertising purposes. Although the flaming carbon arc lamp gives more than three times as much total light for the same number of watts as the enclosed carbon arc lamp which is used generally for street lighting in America, the high cost of the carbons and of trimming due to the high cost of labor in this country, has been largely responsible for preventing the introduction of this lamp for street lighting in American cities. Flaming arc lamps can operate on direct or on alternating current and can also be constructed for constant current or for constant potential circuits.

A striking example of street illumination by flaming carbon arc lamps is found in South Broad Street, Newark. The merchants along three blocks of this street combined with the electric light company to replace the 21 alternating-current enclosed arcs which were used for lighting this portion of South Broad street, by 35 powerful flaming carbon arc lamps, spaced 60 feet apart. These powerful lamps produce a flood of light, attracting attention to this portion of South Broad street.

While flaming carbon arc lamps have been commercially in use for less than ten years it is a noteworthy fact that even before 1880, various investigators in Europe and in America had experimented with carbon arc lamps in which the carbons were treated in various ways with mineral salts so as to produce a luminous arc. Prominent among these early investigators was Edward Weston, who in 1878, secured a patent for this type of arc lamp and actually constructed a considerable number of them. The yellow color of the light and the fumes produced were objected to, however, and these lamps were not generally introduced.

About 1904 a new type of luminous arc lamp was introduced by the General Electric Company, called the magnetite lamp. This lamp was developed with the object of producing an arc lamp which would combine the high efficiency of the carbon flaming arc lamp with the long life of the carbons of the enclosed type of carbon arc lamp. A similar lamp, manufactured by the Westinghouse Company, is known as the metallic flame arc lamp. This type of lamp can operate only on direct current, and is also known as the direct current, luminous arc lamp. The negative electrode consists of magnetite mixed with some titanium salts and compressed into a solid rod, or packed into a thin steel tube. The positive electrode may be any stable conductor and consists in practice of a short piece of copper. A long arc is drawn in this lamp, requiring about 75 volts, the electric current being carried through the vapor stream which issues from the magnetite electrode, and this is slowly consumed. This incandescent vapor stream is the main source of light, the luminous intensity being principally due to selective radiation from the incandescent vapor, with the result that the light emitted is of intense brilliancy and whiteness. The lamp as generally used requires 4 amperes and gives a total amount of light somewhat greater than that given by the 6.6-ampere enclosed, direct current arc lamp, or the 7.5-ampere enclosed alternating current arc lamp, with a corresponding saving in electric power. With this current the average life of a magnetite electrode is about 175 hours. More recently magnetite lamps using 6.6 amperes have been introduced in which the life of the magnetite electrode is about 75 hours. The copper electrode is not consumed, and in practice lasts several thousand hours.

A prominent example of an installation of large magnetite lamps is found in Boston, where recently a large number of 6.6-ampere direct current, enclosed carbon arc lamps have been replaced by 6.6-ampere magnetite lamps, lamp-for-lamp. These magnetite lamps are being operated from the same Brush arc generators which were used with the carbon arc lamps. The same amount of electrical power is, therefore, supplied, but more than double the total illumination is produced by means of these magnetite lamps.

The attempt to produce an equivalent of the magnetite lamp, which would operate on alternating current directly from a constant current transformer, has resulted in the titanium carbide lamp, known also as the alternating current luminous arc lamp, which has been placed upon the market quite recently. This lamp is described by Mr. N. R. Birge, in a paper entitled "The Present Status of the Arc Lamp for Street and Interior Illumination," presented before the 1909 convention of the National Electric Light Association. The upper electrode is titanium carbide compressed into a steel tube. The lower electrode consists of two half-round rods, inclined at an angle, and kept in abutment at the top and in a fixed position by metal fingers forced against the bases. This arrangement maintains the upper ends of the lower carbons, and the arc in a fixed position. The upper or titanium carbide electrode is arranged to be separated from the lower electrode by a lifting magnet when the lamp starts, but no feeding mechanism is provided in the lamp. These lamps are designed to operate in series from a constant current transformer. In order to provide for feeding the titanium carbide electrode, an arrangement is introduced in the circuit on the station switchboard whereby the circuit is instantaneously interrupted by means of an oil switch, automatically operated at intervals of about 20 minutes, thus allowing the titanium carbide electrodes to feed down in each lamp of the circuit. By this arrangement the lamp mechanism is greatly simplified, and it is claimed that the periodical interruption of the circuit is so quickly performed that there is no appreciable effect upon the light of the lamp. In the operation of the lamp both electrodes are consumed, the sizes being so chosen that they need replacing at the same time. The first alternating current, luminous arc lamps were designed to operate on 2.5 amperes, so as to give about the same amount of light as the enclosed 7.5-ampere, alternating current, arc light ordinarily used in street lighting; but lamps for currents of 3 amperes and 4.5 amperes respectively, giving a larger amount of light, are being constructed, for which currents the life of the electrodes is claimed to be about 75 and 50 hours, respectively.

An attempt to produce an enclosed form of flaming carbon arc lamp resulted in the Jandus regenerative flaming arc lamp, which was brought out in England about two years ago. The arc is surrounded by a cylindrical chimney of refractory glass, which opens at the top and at the bottom into metal chambers, which in turn communicate with each other by two curved tubes placed on opposite sides of the glass globe. When the lamp is in operation the hot gases from the arc rise into the upper metal chamber, and, becoming cooled, pass down through the two vertical tubes, depositing the solid particles on the walls of the tubes so that the vapor which enters the chamber from below is freed from these particles. The object of this arrangement is to enclose the arc, restricting admission of air and giving a long life to the carbons, and also to produce a higher temperature of the incandescent vapors. This enclosed type of flaming arc lamp is described by Mr. A. J. Mitchell, in a paper read before the National Electric Light Association, at its annual convention in 1909. A lamp of this type has recently been placed on the market in America for which a life of 70 hours of the carbons is claimed.

A number of carbon arc lamps have been developed in Germany and in France, in which the carbons are made of comparatively small diameter, in order to raise a large portion of the carbon tips to incandescence, and in this way obtain a whiter and more efficient light and also to obtain a better distribution of light. These lamps are principally designed in small sizes, taking a small current, to be used for interior illumination, for which purpose flaming arc lamps are not generally desirable. A lamp of this type, known as the "Intensified carbon arc lamp," has recently been placed upon the market in America, and is described in the paper by Mr. N. R. Birge, referred to above. This lamp consists of a lower negative carbon, of large diameter, and a pair of upper positive carbons of small diameter, inclined at an angle to each other. The upper portion of the lower or negative carbon is kept in a fixed position, while the two small positive carbons are arranged to draw the arc on starting and to feed downward, as they are consumed. In this way the arc is centered in a definite position, so that a reflector can be used for the purpose of projecting the light entirely in the lower hemisphere. The arc is also enclosed by a large hemispherical globe, restricting the access of air, and thereby giving the advantage of the long life of the carbons of an enclosed arc lamp.

Development of Incandescent Lamps.—In the consideration of the development of incandescent lamps it will be convenient to briefly point out the relation between specific power consumption and useful life. Incandescent lamps are commercially rated in terms of watts consumed per mean horizontal candle. It has been found that incandescent carbon filaments gradually volatilize, resulting in a reduction of light and a decrease in efficiency. Experience has shown that it does not pay to operate a carbon filament lamp after it has been reduced to about 80 per cent. of its initial candle power, which point is sometimes called the "smashing" point. The useful life of the lamp, which is the number of hours that it will burn before it reaches this point, depends upon the temperature at which the filament is operated; it has been the practice to operate carbon filament lamps at such a temperature that this will take from 500 to 600 hours, and the specific consumption expressed in watts per horizontal candle is ordinarily based on such a current consumption that will give this life.

The first incandescent lamps, which were introduced commercially in the early '80s, were made by carbonizing a vegetable fiber, such as a thread or a strip of paper. Weston employed structureless cellulose, producing for the first time a homogeneous carbon filament, which he called "tamedine." He also invented the "flashing process," now generally used, which consists in heating the filament to incandescence in a hydro-carbon vapor whereby a dense carbon coating is deposited upon the filament. This made the carbon filaments much more uniform and marked a decided advance in the incandescent lamp. Edison developed the bamboo filament and used this for a number of years. Later all carbon filaments were made by squirting through a die a thick solution of cellulose made from substances such as cotton, then treating, carbonizing and flashing, and this is the method generally employed to-day.

The early carbon filament lamps required 5 to 6 watts per

candle, but improvements in the manufacture of the filaments had improved this specific power consumption to 3.1 watts per candle by about 1888. The high efficiency lamps, having a specific consumption of 3.1 watts per candle, could, however, only be used on circuits having close voltage regulation, as otherwise the life of the lamp was greatly reduced. No radical improvements in carbon filament lamps were made for over 15 years until about 1905, when the metallizing or graphitizing process for treating carbon filaments was developed. This process consists essentially in subjecting the carbon filament to the high temperature of an electric furnace with the result that the filament is partly or wholly graphitized. The filament is then "flashed" and subjected to the electric furnace for a second time. The graphitized or metallized carbon filament lamp, known also under the trade name of "Gem Lamp", has a specific power consumption of 2.5 watts per candle, with the same normal life as is obtained with the ordinary carbon filament lamp. A further remarkable change produced in the carbon filament by the metallizing or graphitizing process is changing the temperature coefficient of resistance from negative to positive, so that the treated filament behaves in this respect like a metal. This positive temperature coefficient makes the lamp much less influenced by fluctuations in the supply voltage.

Since the beginning of this century incandescent lamps containing filaments of metals and giving efficiencies much higher than could be obtained with carbon have been introduced. Osmium was the first metal tried and a fairly satisfactory lamp, having a specific power consumption of 1.5 watts per candle, was obtained. A number of osmium lamps have, in fact, been used commercially in Germany. However, the very limited available supply of osmium has prevented the commercial introduction of the osmium lamp on a large scale.

About the year 1904 lamps employing tantalum filaments were placed on the market, having an efficiency of about 2 watts per candle, with a useful life greater than that of the carbon filament lamp on direct current circuits. Processes were developed for producing pure, ductile tantalum which was then drawn into fine wires for use in the lamps, and these tantalum lamps have come into considerable commercial use. A peculiarity of the tantalum lamp is that it has a short life when used on alternating current. The lamp is, therefore, inherently a direct current lamp.

About the year 1905 incandescent lamps, having filaments of tungsten, were brought out in Germany, having an efficiency of about 1.25 watts per candle with a useful life claimed to be greater than that of the carbon filament lamp and equally good on alternating and direct current. These were quickly introduced on a large scale. The manufacture of tungsten lamps was also started in America about 1907, and these lamps are now rapidly coming into use. The present very high cost of these lamps is, however, a serious obstacle to their general introduction. Since tungsten is not ductile, the tungsten filaments cannot be drawn into fine wires as in the case of tantalum. The production of a filament of tungsten, therefore, presents many difficulties with the result that a number of different processes for producing these filaments have been developed. Since the specific resistance of tungsten is very much less than that of carbon, a filament of tungsten for a lamp to be operated at a given voltage must be very much thinner and longer than a carbon filament for the same voltage. For this reason tungsten filaments are admirably suited for heavy current, low-voltage series lamps for use on constant current circuits for street lighting. Multiple lamps for 110-volt, constant potential circuits are now also manufactured in sizes down to 20 candle power, but the filaments in these lamps are extremely small in diameter. When the tungsten filament is incandescent it is extremely soft, and the loops, especially those for high voltage lamps, require supports to keep them in position. The first tungsten lamps were for this reason capable of operating only in a vertical downward position. The lamps have been so improved that they can now operate in any position. The tungsten filament is, however, extremely fragile, making it liable to become broken when subjected to vibration, so that these lamps are not suitable where subjected to vibration, as, for instance, on trains or boats. In these latter places the tantalum lamp is frequently used.

Both the tantalum and tungsten filaments have a positive temperature coefficient, and for this reason are less affected by fluctuations in line voltage than ordinary carbon filaments. The light given by tantalum and tungsten lamps is also much whiter than that given by carbon filament lamps owing to the higher temperature at which these filaments are operated. Another peculiarity of these metal filament lamps is that they do not depreciate from their initial candle power until the filament finally breaks. It is at times even possible to repair a ruptured tantalum or tungsten lamp filament by judiciously shaking the lamp with the voltage on, until the broken ends of the filament come in contact and are welded together by the intense local heat at the point of contact. Such a weld is frequently quite strong, enabling the lamp to continue in service for a considerable time.

A prominent example of an installation of tungsten lamps for street and park lighting is found in Riverside Park and Riverside Drive, High Bridge Park, and St. Nicholas Park, New York City, where the New York Edison Company has recently installed about 300 75-watt 60-candle power tungsten lamps, mounted on lanterns of special design and carried by ordinary posts about 10 feet high from the surface of the ground. These lamps are supplied in multiple from the ordinary Edison three-wire system by means of buried cables, making it an unusually attractive lighting installation. This installation is described in a paper by Mr. S. G. Rhodes, in the February, 1909, issue of the "Transactions of the Illuminating Engineering Society."

Another form of incandescent lamp which has been proposed, but which has not been introduced commercially, is the Helion lamp invented by Messrs. Parker and Clark, of New York City. The filament for this Helion lamp is made from a carbon filament by subjecting it to heat treatment in a gaseous compound containing silicon. It is stated that the filaments take on a surface deposit of silicon, and, with this surface deposit, a greatly increased efficiency and a much greater whiteness of light are obtained. A desirable quality of the Helion filament is its very high specific resistance, giving a comparatively short and thick filament for 110 volts and making the lamp suitable for higher voltages. A peculiarity of the Helion lamp is that it does not require a vacuum for its operation, but can be used in the open air.

The advances made in the construction of incandescent electric lamps is well shown by the following table, giving the approximate dates when each lamp was introduced in America, and the specific power consumption expressed in watts per mean horizontal candle and in watts per mean spherical candle. The latter figures are obtained from the former on the assumption of a spherical reduction factor of 0.8:

Type of Lamp	Approximate date of introduction.	Watts per mean horizontal candle.	Watts per mean spherical candle.
Early carbon filament	1880	4 to 6	5.0 to 7.5
Improved carbon filament	1888	3.5 to 3.1	4.4 to 3.9
Metallized or graphitized filament	1905	2.5	3.1
Tantalum.	1904	2.0	2.5
Tungsten	1906	1.25	1.56

An interesting departure in the construction of an electric lamp of the incandescent type is the Nernst lamp, which was first brought out by Dr. Nernst, in Germany, about the year 1898. The Nernst lamp has been commercially developed in America by the Nernst Lamp Company, one of the Westinghouse interests. The light-giving conductor, or glower, as it is called, consists of a cylindrical piece of porcelain-like material, from one-half to about one inch in length, for circuits of from 100 to 250 volts. This glower is made from a suitable mixture containing the oxides of rare metals, similar to that used in making Welsbach mantles. The peculiar characteristic of this glower is that it is an insulator when cold, but becomes a good conductor and an excellent and efficient illuminant when heated to a high temperature. It is, therefore, necessary to employ a device which will heat the glower on starting to a temperature at which it will conduct electricity, after which the current will maintain the glower heated and conducting. It is also necessary to provide an automatic cut-out for cutting the heater out of circuit after the glower has been made conducting. This heater consists in practice of a very fine platinum wire wound upon a small tube or thread of clay and placed close to the glower. The glower is not enclosed in a vacuum, but is surrounded by a glass globe to prevent too rapid dissipation of the heat of the glower. Another characteristic of this glower is that it has a negative temperature co-efficient, so that if it were connected to constant potential mains it would burn itself out after it has been heated and rendered conducting. In this respect it resembles an electric arc. For this reason a steadying resistance, called a ballast, must be added in series with the glower. In the Nernst lamp, the glowers take from 60 to about 120 watts, and, as made in America, from one to four glowers are employed in one lamp, giving from 50 to

about 500 mean, lower, hemispherical candles. The heaters are placed horizontally above the glowers. Owing to the high temperature at which the glowers operate, a brilliant white light is obtained, which makes the light very desirable where colors should appear as nearly as possible the same as in daylight. The glowers and heaters have a life of 500 to 800 hours, and these are mounted together and are so arranged that they can be easily replaced. The ballast resistances have a life of several thousand hours, and can also be readily replaced. The first Nernst lamps manufactured in America were designed to operate on alternating current, and these gave only a short life on direct current. Later, Nernst lamps, giving a long life on direct current, were also introduced. Practically all of the light from a Nernst lamp is projected downward in the lower hemisphere, and hence no reflector is ordinarily required. The lamp is peculiarly well adapted for illuminating large interiors, such as stores, etc. These lamps have recently been greatly improved in efficiency, and the makers now claim a specific power consumption of about 1.2 watts per mean lower hemispherical candle. These Nernst lamps start in 20 to 30 seconds. A special Nernst fixture has also been placed on the market during the past year, in which the automatic cutouts and ballast resistances are attached to the fixture; the glowers and heaters are secured to a porcelain base and surrounded by a glass globe, the base having a screw contact attachment so as to permit of being replaced by unscrewing exactly like an ordinary incandescent lamp. Recently a luminous type of heater has also been developed which gives some light instantly, thereby producing a partial illumination before the glower has become active. It is claimed that with this new heater the glowers will start in 10 to 15 seconds.

Nernst lamps are generally used in multiple, on constant potential circuits, for indoor lighting. The largest single installation of Nernst lamps in America is in the Marshall Field & Company's stores, Chicago, where about 14,000 glowers are connected on direct current circuits, taking the place of about 57,000 16-candle power incandescent lamps. Nernst lamps can also be used on constant current alternating current circuits for street lighting by using a special form of series transformer for each lamp.

Development of Vapor Lamps.—Luminous effects produced by means of electric discharges through gases or vapors enclosed in glass tubes, exhausted to a partial vacuum, date back to the famous Geissler tubes, which were developed about the middle of the last century. These were, however, used only for lecture room experiments illustrating electric discharges, and no attempt was made to use them as sources of light. Electric lamps in which gases or vapors are raised to incandescence by an electric current have, however, been developed commercially during the past twenty years. The two leading types of vapor lamps developed in America are the Moore vapor lamp, or Moore tube, and the mercury vapor lamp.

The Moore tube was first described before the American Institute of Electrical Engineers, in 1896, by the inventor, Mr. D. McFarland Moore, and aroused considerable interest owing to its being totally different from other illuminants and embodying a number of remarkable properties. In its original form this lamp consisted of a glass tube containing highly rarefied air or other gases, and heated to incandescence by high potential electric discharges. The energy for exciting these tubes was derived from the inductive kick of a coil, whose circuit was rapidly interrupted by a mechanical break in a high vacuum. The chief difficulty found with these tubes was that the vacuum increased as the tubes were used until the electric discharges could not be forced through them, thus giving the tubes a comparatively short life. After about ten years of study and experiment, Mr. Moore finally overcame this difficulty by providing a most ingenious automatic feeder valve, called a vacuum regulator, which admits to the tube at suitable intervals a minute quantity of gas to supply the losses which occur during action. The color of the light in this lamp depends upon the gas within the tube, and for obtaining light of different colors tubes containing various gases have been made. For instance, ordinary air gives a light of a distinctly pink color; nitrogen, which can be obtained by drawing air over phosphorous to remove the oxygen, gives a golden yellow light, while carbon dioxide gives a white light. The Moore vapor lamp, as placed upon the market during the last few years by the Moore Electrical Company, of Newark, N. J., consists of a glass tube about 1.75 inches in diameter, and of a length varying from 25 to 200 feet. The ends of this tube terminate in a metal box, which contains all the auxiliary apparatus, and from which the tube proceeds over any desired path throughout the area to be illuminated and without any wires. The tube is excited from the secondary of a high potential transformer, whose primary is connected to the regular alternating current lighting circuit, the current being introduced through platinum wires sealed into the glass tube at each end and connected to carbon electrodes in the interior of the tube. The Moore lamp is, therefore, essentially an alternating current lamp, and requires a frequency of at least 60 cycles per second for satisfactory operation. The light from the Moore tube is of low intrinsic value, running in practice in the neighborhood of 10 candles per foot of tube, this giving an ideal diffusion of light. As there is nothing which deteriorates in the operation of a Moore tube, its life is very long. An interesting and unique example of Moore tube lighting is to be found in the New York Post Office, where the mezzanine floor is entirely lighted by Moore tubes arranged in 35 parallel rows, each 114 feet long, placed directly under the ceiling.

Vapor lamps are not directly comparable with other sources of light in an ordinary photometer due to the large linear dimensions of these lamps, and, in the case of mercury vapor lamps, also due to the wide difference in color. These lamps should be compared with some form of luminometer by which the illumination produced is measured. From this a figure equivalent to spherical candle power can be derived. For the Moore tube a specific consumption of about 1.5 watts per equivalent candle power is claimed. Sharp and Millar report 2.49 watts per equivalent spherical candle power, for a Moore tube installed in 1907, in Assembly Room No. 7 of the United Engineering Buildings.

The mercury vapor lamp depends upon the production of an arc between a negative electrode of mercury and a positive electrode of mercury, carbon, iron, or other suitable conductor within a transparent tube, exhausted so as to contain only vapor of mercury. The mercury vapor lamp was developed by Dr. Peter Cooper Hewitt, in 1901, and was shortly afterward placed upon the market by the Cooper-Hewitt Electric Company, one of the Westinghouse interests. This lamp consists of a glass tube about one inch in diameter, and, for 110 volts, about 4 feet in length. The mercury vapor lamp is inherently a direct current lamp, but has recently also been manufactured for alternating current circuits. In the direct current lamp there is a positive electrode, usually of carbon or iron, at the upper end of the tube, and a negative electrode of mercury at the lower end; this end of the tube is provided with a condensing chamber, in which the vaporized mercury issuing from the negative mercury electrode is condensed and returned, thus constantly reconstructing this electrode. The positive electrode undergoes no change. To force an initial current through the mercury vapor of a lamp would require several thousand volts; after a current has once started, however, the voltage required to maintain the flow of current is comparatively low. The high resistance to starting is found to exist almost entirely at the surface of the negative electrode. The lamp is usually started by tilting the tube until the mercury bridges across the gap between the electrodes, thus striking an arc, and this may be accomplished by an automatic device. A special starting device, employing the high voltage discharge from an inductance coil, has also been developed. The mercury vapor lamp requires a steadying resistance or ballast in order to operate on constant potential like an arc lamp. A peculiar feature of this lamp is that if the current is interrupted for even the briefest possible moment the arc is immediately extinguished and cannot be re-established without first breaking down the resistance at the surface of the negative electrode. Thus the lamp can be made to operate only on alternating current by embodying the principle of the mercury vapor rectifier. Instead of the single positive electrode there are provided two positive electrodes, which are connected to the ends of the winding of a suitable transformer. The negative mercury electrode is connected through an inductance and a ballast resistance to the middle point of the transformer winding. The arc is started by means of an auxiliary starting electrode, as in the case of the rectifier. During the successive half waves, current flows alternately from each of the positive electrodes through the vapor in the tube to the negative electrode. Thus the successive half waves travel down the tube in the same direction, and if sufficient inductance is present there is no perceptible flicker in the light. The most important characteristic feature of the mercury vapor lamp is its color, which is a bluish-green, corresponding to the spectrum of mercury. The light is practically void of red rays so that red articles appear black, and colors are generally distorted, which makes the lamp unsuitable for use where colors are to be matched or compared. These lamps, are, however, successfully used in machine shops, press rooms and similar places where details must be accurately

seen, but where color distortion is no disadvantage. Owing to its very strong actinic rays, the lamp also has considerable value for photographic purposes. Dr. Bell gives a specific consumption of 0.6 to 0.8 watt per equivalent candle power for these lamps.

Cooper-Hewitt mercury vapor lamps have been constructed with tubes bent into a circular form, so as to fit in a diffusing globe. In some cases incandescent lamps have been added in the fixture for the purpose of supplying the red rays missing in the mercury vapor light. A prominent example of commercial lighting by units combining a Cooper-Hewitt mercury vapor lamp with a tungsten incandescent lamp, is found in the editorial offices of the New York World, where 36 of such light units have been in use since May 1, 1908. Each light unit or combination lamp, as it may be called, consists of a Cooper-Hewitt mercury vapor tube bent into circular form of about 10 inches diameter, with a tungsten lamp in the center. The vapor tube and tungsten lamp are attached to an ornamental metal fixture provided with a white, corrugated reflector and surrounded by a 16-inch holophane hemispherical globe. The combination lamp is designed to operate on the 120-volt Edison circuit, and to take a current of 2 amperes, thereby consuming 240 watts. The vapor tube and tungsten lamps are connected in series, the vapor tube taking about 52 volts and the tungsten lamp about 58 volts, the remaining 10 volts being taken up by steadying inductance. An automatic device consisting of an inductance coil with a quick mercury break in vacuum, called a shifter, is placed in the fixture for starting the lamp. Tests of the illumination produced by this installation, made by means of a luminometer, and of the power consumed, are described by Mr. Albert J. Marshall, in the April, 1909, issue of the "Transactions of the Illuminating Engineering Society." Mr. Marshall states that the candle power of the tungsten lamp is about 80, and of the Cooper-Hewitt vapor lamp about 200. With a power consumption of 240 watts, this gives an equivalent specific power consumption of 0.86 watt per equivalent candle.

In attempting to improve the color of the mercury vapor lamp there have been developed quite recently in Europe new types, which have been referred to as the high pressure mercury vapor lamps. The two most prominent examples of this type are the Bastian lamp, brought out in England, and the quartz tube, mercury vapor lamp, brought out, first, in Germany, by Richard Kuch. In the Bastian lamp the arc is produced in a tube of refractory glass about an eighth of an inch in diameter and 9 to 10 inches long, for lamps which are designed to operate at about 110 volts. The intensity of the arc, combined with the small size of the tube, causes the pressure of the mercury vapor to rise to much higher value than with the Cooper-Hewitt form of lamp. This greatly increases the temperature of the mercury vapor, and consequently greatly improves the color of the light, the yellow rays becoming very pronounced. In the lamps due to Kuch there is used a tube of fused quartz in which the arc can be run at a very high temperature. This lamp has a tube about 3 inches long for a pressure of 110 volts. The quartz tube mercury vapor lamp has already become commercial in Germany. Its specific power consumption is quoted as 0.2 watt per mean spherical candle. None of these high-pressure mercury vapor lamps have so far been used in America.

Development of Machinery and of Systems of Distribution.—The first electric lighting of commercial importance was accomplished by means of direct-current, carbon, open arc lamps, connected in series and supplied from constant current dynamo machines, and by the year 1880 a number of such systems had already been developed and introduced for street lighting. During the following five years street lighting by direct current series arc lamps spread very rapidly both in Europe and in America. The Brush arc dynamo machine developed during this early period has survived to the present day, and is still largely used for series direct-current arc lighting systems. Efforts to introduce series arc lamps for indoor lighting were also made as early as 1878 by Weston, Brush, and by others, but did not meet with favor largely because the arc lamp was too large a light unit and because the color was too different from the accustomed gas flame; the introduction of the incandescent lamp soon afterwards discouraged attempts to use arc lamps for general indoor lighting at this time.

The introduction of the commercially successful incandescent lamp in about 1880 brought about the development of constant-potential dynamo machines and systems of distribution. Direct-current at from 100 to 125 volts pressure was generally used, and the 16-candle power lamp was adopted as the light unit, and in fact constant potential dynamo machines were frequently rated by the number of 16-candle power lamps which they could supply. The Edison and Weston incandescent lamp systems were soon generally used for isolated plants. Edison immediately set to work to develop a complete system of electric lighting which would parallel the gas lighting systems in use. His scheme involved a central station, a system of underground conductors and house wiring supplied from these underground conductors. In the summer of 1880, Mr. Edison installed such a system at Menlo Park, lighting houses and streets with 425 18-candle power lamps, the out-of-door lamps being mounted on poles. In 1881 the Edison Illuminating Company, of New York, was organized, which company immediately started to erect its first central station, namely, that in Pearl Street near Fulton Street. This station was started in 1882, and supplied during the first month 85 houses wired for 2323, 16-candle power incandescent lamps. From this pioneer installation the present system of the New York Edison Company, which is the largest electric lighting company in the world, has developed. This pioneer installation was operated on a two-wire system; the high cost of copper conductors suggested the use of the three-wire system, which was quickly adopted. Soon after the New York company was started Edison Illuminating Companies in many of the large cities of this country and of Europe were likewise started, these companies all being licensed under the parent company known as the Edison Electric Light Company.

About 1885 the alternating current transformer was introduced. This made it possible to generate and distribute alternating current of high voltage, and by means of these transformers located on poles or on customers' premises to reduce this high voltage to the voltage required by incandescent lamps connected in multiple. Systems were quickly developed consisting of alternating current generators producing generally 1,100 volts at a frequency of 133 cycles per second, which current was distributed to the transformers whereby the voltage was reduced to 55 or 110 volts for supplying incandescent lamps in multiple. The alternating current transformer system of distribution was pushed most actively by the Westinghouse Company, and this system immediately found extensive introduction in smaller cities and suburbs where the direct current system could not be economically operated because of the high cost of the copper required. With the introduction of the alternating current system a heated rivalry started between the advocates of the direct current system and the advocates of the alternating current system. However, soon each system found its own proper field of application, the low-tension, direct current system for isolated plants and for congested areas in large cities, and the alternating-current system for small towns and for outlying districts, and the two systems have retained these separate fields to the present day.

The incandescent lamp was primarily introduced to be used in multiple on constant potential circuits for indoor lighting, and this has remained its greatest field of application. From the early days to the present, incandescent lamps have, however, been used in series on constant-current circuits for street lighting where small light units were desirable, as for streets of villages and suburban towns, shaded parks, etc. Constant current for series incandescent lamps was originally obtained from constant potential dynamo machines by the use of some hand-regulating device arranged on the station switchboard. Since constant current transformers were introduced, in about 1902, these series incandescent systems have been most generally supplied from such transformers.

From the first installation up to about 1895, the Edison stations were equipped with direct current dynamos driven by steam engines. From the 125-horse power "Jumbo" dynamo, of 1881, the direct current dynamo machine was developed into the multipolar form in sizes up to about 2,500-horse power. About 1895 polyphase alternating currents came into use, and the rotary converter as a means of changing polyphase alternating current into direct current had also become a practical machine. This development made it possible to generate electric power as high voltage alternating current, transmit this for considerable distances and then convert into direct current. Since the end of the '90s, Edison companies in the large cities have quite generally substituted for the scattered direct current steam generating stations, rotary converter sub-stations, receiving their power from one main generating station in the form of 3-phase, 25-cycle, 6,600-volt, or 11,000-volt alternating current.

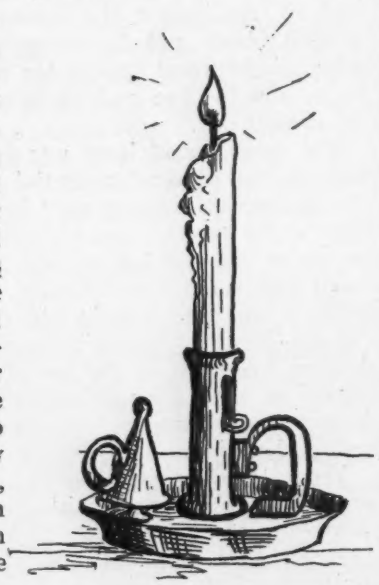
Alternating current series arc lamps are most generally supplied from constant current transformers. Direct current series arc lamps are still largely supplied from constant current dynamo machines, principally of the Brush type. About six years ago the mercury arc rectifier was developed by Dr. Peter Cooper-Hewitt, by which it was made possible to change alternating current to

direct current in a simple and efficient manner without moving machinery. This mercury arc rectifier, combined with the constant current transformer, makes it possible to obtain a constant direct current for operating direct current arc lamps in series, the power being supplied to the constant current transformer from constant potential alternating current generators and generally at very high voltage. Constant direct current systems employing this arrangement of constant current transformer and mercury arc rectifier have come very largely into use during the last few years, and are taking the place of constant current dynamo machines.

Dynamo-electric machines have been developed from the Edison 125-horse power "Jumbo" dynamo, of 1881, which was then considered "gigantic," to alternating current generators having normal ratings of 5,000, 10,000 and 14,000 kilowatts, with an overload capacity at least 50 per cent. greater than normal rating. These generators produce generally 3-phase, 11,000-volt, alternating current; the usual frequency is 25 cycles per second, where the alternating current is to be used to drive motors or to supply rotary converters for conversion into direct current. Where the alternating current is to be used for lighting arc or incandescent lamps the usual frequency in America is 60 cycles per second. An idea of the enormous capacity of a 14,000-kilowatt dynamo machine, the largest so far built, may be gained by considering that this machine is capable of supplying continuously electric current to 560,000, 25-watt, 20-candle power tungsten lamps, giving an aggregate light equal to 11,200,000 candles. This practical subdivision of the electric light into over one-half a million units from a single dynamo machine is especially remarkable when it is considered that only 40 years ago a number of leading scientists, both in Europe and in America, positively stated that the subdivision of the electric light was a physical impossibility.

Development of the New Business Division of the Gas Industry in the Last Fifty Years.

[Prepared by Mr. PHILMER EVES, Sales Agent, the Indianapolis (Ind.) Gas Company.]

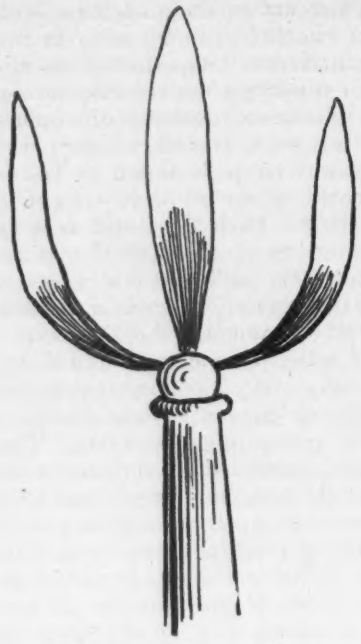


Fifty years ago there was no "New Business Department" of a gas company; that is as we know it now. The term applies to the present comprehensive commercial organization as evolved from the crude selling conceptions and limited possibilities of the earlier days of gas. Although gas had been installed in Baltimore as early as 1821, and in many of the principal cities, from Boston and New York to San Francisco, before 1859, it was not until after the latter period that steps were taken to increase gas sales. To the commercial men of to-day the pioneer efforts, difficulties, competition and gradual growth of the sales department form a fascinating and instructive study.

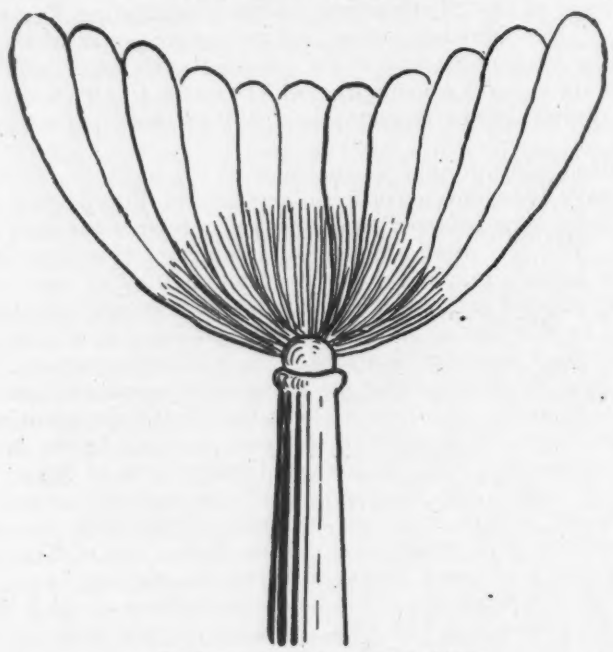
IN THE EARLY DAYS.

The first endeavors to demonstrate the few uses for gas comprised the installation, in the primitive gas office, of one or two chandeliers ("gasoliers" was what the gas men tried to have them named) equipped with up-to-date iron gas burners, a "drum gas heater" or two, and occasionally a "flat, fireplace gas stove." One of the first "Gas Tips" read: "Every one that uses gas is advised to get clean burners or clean the old ones out by passing a sheet of writing paper through the slit in the top of the burner." The infant mind, so-to-speak, of the gas consumer was beginning to be gently moulded.

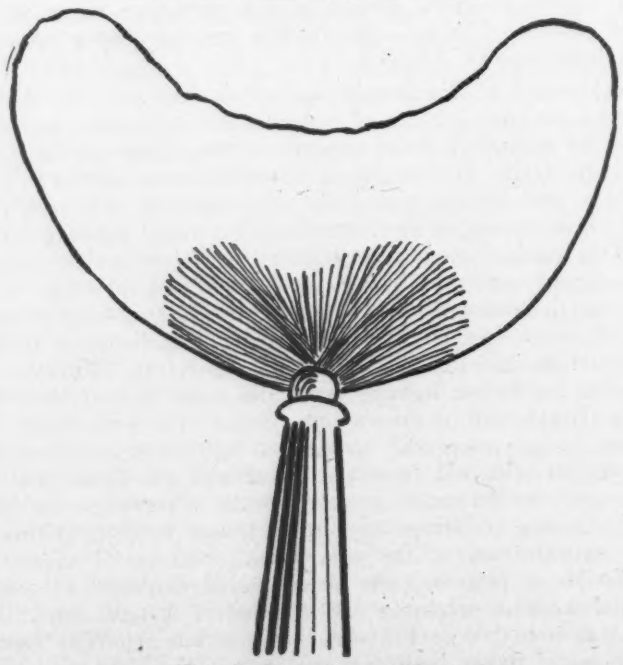
It was at this epoch, fifty years ago, that the AMERICAN GAS LIGHT JOURNAL appeared, and the bright star that was then welcomed in the East soon spread its illumination and encouragement among the comparatively few gas men who were blazing the gas trail over the oil lands of the West. Wax, sperm oil and petroleum had been for 50 years the most potent factors in artificial illumination. The gas companies had not thought of entering the field of



Cockspur Burner from an Old Cut.



Fan Burner (Union Jet), from an Old Cut.

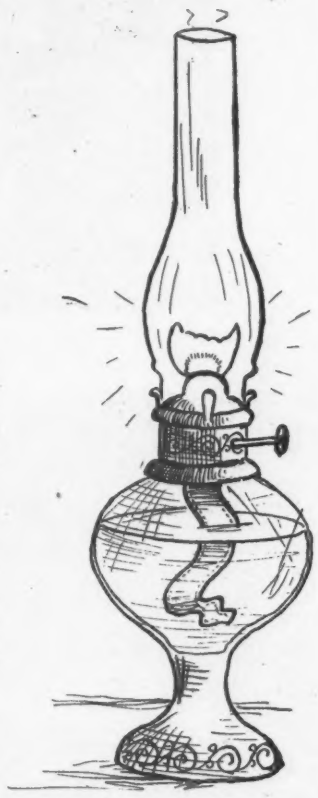


Batswing Burner from an Old Cut.

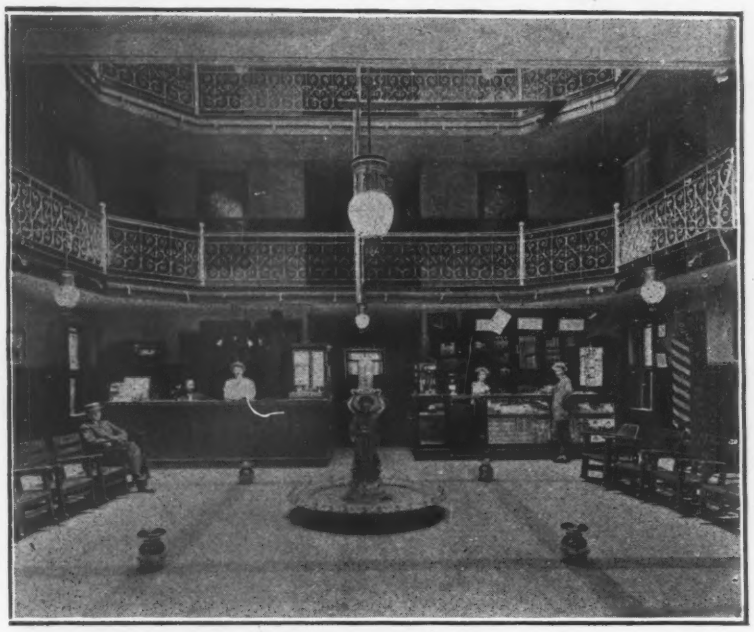
publicity against this competition. Gas was $3.50 to $5 a thousand then. We searched in vain among the papers of the period to find

the old style of gas advertising, but although newspaper space could be had in "squares" instead of inches, gas companies made very few "square" deals then. Soon after the period when the JOURNAL appeared, we read, "Gas has now become a fully established source of illumination and heat." The old "cockspur," "fan" and "batswing" burners, which had so long survived, were displaced by the Argand gas lamp, an improvement on the old Argand oil burner, and progress began. At this time we find the following curious announcement: "If a pipe from the top of each lamp be led into the open air or into the chimney of the room, not only are its products of combustion carried away but the gas burners themselves often become powerful and efficient ventilators." Imagine a number of flue pipes attached to the Welsbach lamps of to-day! But these were the earlier efforts to sell gas. This ventilating idea appears to have been well followed up. In theaters, concert rooms, lecture halls and other buildings, gas lighting was utilized to supplement the ventilating arrangements by the heat drawn up the ventilators. Experiments showed that 35 feet of gas produced a discharge of 13,650 cubic feet of air "thereby bringing in a fresh supply equal to from 14,000 to 15,400 cubic feet." Many an old-fashioned inn room was cleared of tobacco smoke in this novel way. The embryo new business department was developing very nicely. In the early '60s attempts were made to heat boilers by artificial gas, but it was found that the expense was at least six times greater than the cost of coal, and "few persons could be induced to adopt this mode of warming after they became really aware of the expense."

LIGHTING.

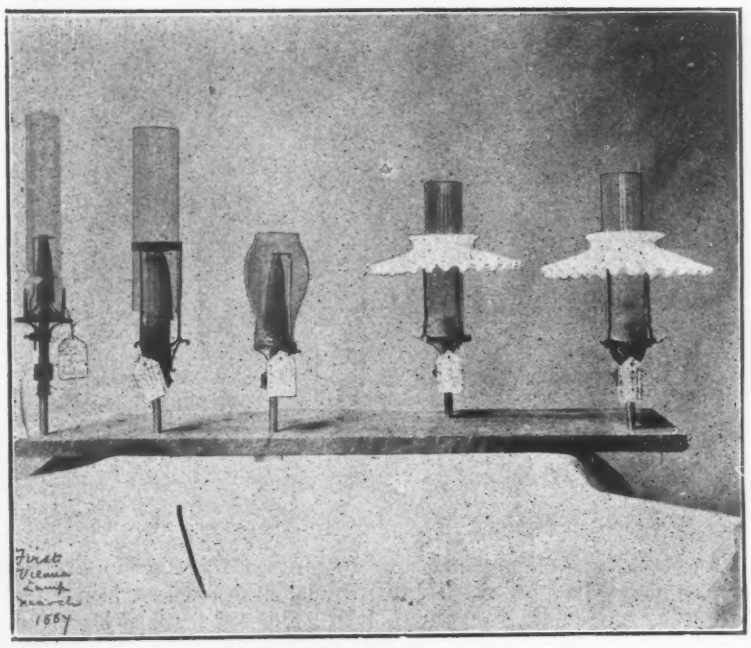


Candles and kerosene were formidable competitors for the lighting patronage. The appearance of the Siemens-Lungren gas lamps somewhat altered these conditions and this brilliant event caused much triumphant rejoicing in the gas office. The candle maker then improved upon the older plan of dipping the candle wicks in lime to avoid flickering and to obviate the necessity of "snuffing." The business truism that "competition means progress" is illustrated in the fact that, notwithstanding all its rivals, including gas, the candle is now, in 1909, showing larger sales than ever before. In 1870 Professor Tyndall came to the United States to deliver lectures on a new light produced from electricity. In 1876 there were two electric light exhibits at the Centennial Exhibition at Philadelphia. Electricity was, therefore, another powerful claimant for the lighting business. On April 16, 1873, the American Gas Light Association had its first meeting, and the gas companies began a few years afterwards to provide more suitable show rooms. Buffalo opened its department in 1879, but newspaper space was not utilized to any extent until 1886. From that year until 1896 there appears to have been a pronounced development in new business activities. The cause of this new life was the appearance of the Welsbach mantle. The Welsbach gave six to seven times greater light than could be obtained from the best burner known 30 years before, and the average price of gas had come down to $1.035 per 1,000. The records of gas sales showed millions instead of thousands of cubic feet, and in all departments of the lighting business there appeared evidence of progress. In the lighting of residences, store interiors, public halls, etc., the aim of the salesmen was successfully directed towards securing the best possible illumination and economy of operation. The anti-vibration fixture made it practicable to extend gas lighting to factories, workshops and similar places. Artistic fixtures and glassware, portable lamps, decorated shades, domes, reflectors, mosaic art glass and many other embellishments brought gas to a high plane and enabled the sales department to meet all competition. Show window and store illumination by the incandescent gas light and gas arc lamps made rapid strides. Such types of illumination has been responsible for much of the money made by merchants in the public store business. In the sales of gas arcs Denver, Chicago, Milwaukee and many other cities have made splendid records. Street gas lighting has been extended everywhere, and the illumination of railroad cars with gas has long been an established success. Steady improvements in the efficiency and economy of Welsbach lamps and, later,



Gas Arc Lighting.

Gas Advertising Sign.



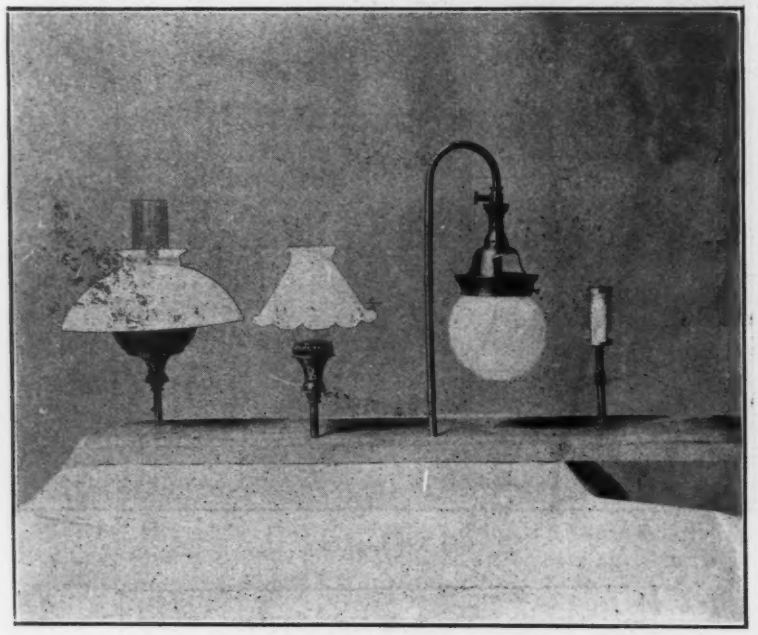
First Vienna (Welsbach) Lamps. March, 1887.

the appearance of the inverted types, reflexoliers, "junior" lamps, which enable the consumer to use his own chandelier globes, gas advertising signs, pneumatic lighters, time clocks and other varieties

of lighting devices and accessories have enabled the sales representatives, in competition with the tantalum and tungsten electric lamps, to show steady progress.

Heating.

In the years 1860-64 "Goddard's gas stove" and "Ward's fireplace gas heater" were in vogue. The gas salesmen met with considerable difficulty and opposition by the prohibitive cost of opera-



Welsbach Lamps, March, 1909.

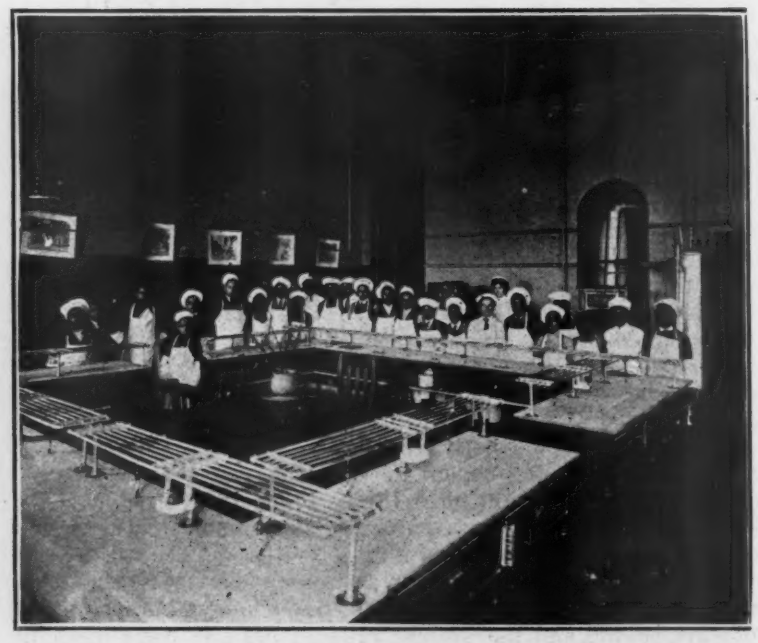
tion and the use of the fireplace heaters in "blind" chimneys. Cheaper gas, the building of open chimneys, and the more perfect combustion secured in the best styles of gas heaters of later times, have overcome these objections, so that there have been few gas companies that have not increased their sales by advocating the convenient and quick service of these gas appliances for occasional and supplementary heating. The gas log, the radiator with its

Gas Heater Display.

"jewels," imitation coal fires, gas steam radiators and many ingenious and attractive heating stoves have been well utilized in securing new business.

The Gas Range and Cooking.

In the early '70s gas found its way into a few kitchens to be used as a fuel in cooking. In this country the old cast iron "Retort" stove, made in Providence, R. I., appears to have been the pioneer gas range. Then came the Goodwin "Sun Dial," with its tin broiling pan underneath a small baking oven. Of these smaller forms of range many were sold and rented out by gas companies. Manufactories gradually increased in number and capacity and by the year 1900 there were 35 establishments making gas stoves. Prior to that time a few gas companies made their own ranges. In the public schools model cooking kitchens were instituted and the sales department became deeply interested in the movement. To keep in touch with the education of "the little housewives of the future" has been in some cities considered an essential part of the work of the modern sales manager. In southern and western cities these cooking departments have been extended to embrace classes for colored children. By assisting and advertising these classes the new business agents have been able to reach the patronage of the colored population and have helped to popularize gas for cooking among colored cooks.



Cooking Class for Colored Boys, Indianapolis, Ind.

The importance of winter gas consumption from the gas range has not until lately received as much attention as other branches bringing fewer advantages and smaller profit. The "Kitchen Heater," or coke attachment, which is incidentally an additional outlet for the disposal of gas coke, has been welcomed as a partial aid along these lines. The "Furnace Connection" also has been advocated as a means of heating the kitchen and the water in the boiler. Omaha and some other cities have devoted much successful effort to this important matter. The traveling salesmen of the stove manufacturers of to-day are a credit to the commercial profession. Progress in the science of salesmanship has been noticeable in this as well as in the other departments of the gas and allied industries.

DEMONSTRATIONS.

Cooking lessons, lectures in domestic science and practical demonstrations of gas ranges, water heaters, mechanical appliances, domestic irons, burners, lamps, etc., have been generally adopted as a means of advertising the appliances and of giving instruction in their proper and economical use. Two novel schemes have been tried with remarkably satisfactory effect in Indianapolis, where a

The "Child Cook" Demonstrating in the Sales Department of the Indianapolis Gas Co.

"child cook," eleven years of age, and a blind woman, have been introduced as demonstrators. To see "the youngest demonstrator in America" and the surprising success of the cook, who, without sight, could so easily manipulate a gas range, produced powerful publicity in the newspapers, and a persuasive argument against the dubious notions of non-users of gas for cooking. On a loftier plane the educational influence of the domestic science lecturers, among whom Mrs. Sarah Rorer, Mrs. Helen Armstrong and Miss May Irwin must gratefully be named, has done much to bring about those revolutions in kitchen ideas which have given such impetus to gas range sales. Buffalo, Providence, Sioux City, St. Paul, Boston, New York, and other cities began early in this progressive work.

In some cities organized cooking lectures in connection with the churches, which have occasioned announcements and invitations from the pulpit, and, in one instance, the ringing of the church

Cooking Class for Colored Cooks, Indianapolis, Ind.

bell, have resulted in an acquisition of good will and sales to the companies.

Cooking meetings for colored cooks, domestic science classes for nurses at the public hospitals, lectures to trained nurses and pupils of the public school cooking classes, cooking lessons by a child cook

Lecture on "Invalid Diet" to the Trained Nurses of the Public Hospitals and the Pupils of the Public School Cooking Classes, Indianapolis, Ind.

to children, male demonstrators and many other agencies and operating forces of the New Business Division have popularized gas for fuel to an extent that would have been deemed impossible in "the good old times."

The grand result of these effective efforts may be seen from the following statistics, which have been compiled from reliable sources and are given as the approximate figures for the close of 1908:

Number of miles of mains in 46 States..... 42,598
Number of gas ranges sold by gas companies and other agencies.....3,219,569

Think of it! Over three million gas ranges! This almost incredible number works out to an average of 75.5 per mile of main.

One of the Cooking Classes for Trained Nurses, conducted by the Indianapolis Gas Co.

Piping and Gas Fixtures.

Many plans have been evolved in securing piping business and the installation of lighting fixtures. The prices "per room," "per foot" and "per outlet" have had their advocates. The co-operation of gas fitters and plumbers, a desirable asset, has been secured by many of the companies, while others have preferred to do piping work at cost or at prices lower than those charged by the public fitters. A method has been successfully followed whereby practically all these plumbing agencies have agreed to a uniform charge, the orders obtained by the gas company being given for execution to the plumbers who, in return for the concession, secure new piping business and report, on cards furnished by the company, all work done. This plan has increased the number of installations, helped to keep the solicitors' cards up-to-date and enabled the solicitors to follow up "prospects" for further business. Many companies have handled fixtures at cost or on the small profit basis. Some have purchased the pipe casing, arms and trimmings, and assembled their own fixtures. Others have left this part of the business to the fixture dealers. Framed copies of the gas company's "Rules for Piping Houses," presented to plumbers and gas fitters, have had a good advertising effect and prevented those undesirable changes and errors in piping jobs so common in the younger days of the business.

Water Heaters.

A "growing demand" has been created for the circulating or "tank" water heater. Its earlier faults have been corrected, its efficiency greatly increased and the old troubles from rust and liming have been almost banished by brass and copper coils and improved sections. The instantaneous water heaters of the bath-room type have also given gas an enormous impetus and the more recent developments, with thermostatic control of the water temperature and cost of operation, have materially influenced the sales and opened up opportunities that are now being followed up by means of displays and practical demonstrations in the sales rooms. It is estimated that, from 50 to 55 water heaters of the various types per mile of main, will represent the average work accomplished in this department.

Power.

Fifty years ago the gas engine was doing some service. From 1826 to 1859 many practical improvements were made in the early engines, but it was not until 1870 that the makers were able to solve the problem of governing for variable loads and perfecting the four-cycle system. The sales of gas for power purposes then rapidly increased. During the last decade the gas salesmen have fought strenuously against the competition of the electric motor and gasoline, and have not only sold and erected gas engines, but converted thousands of gasoline engines to use gas; 301 horse-power was the year's record of these gasoline conversions in one city with gas at 90 cents. The effort that is now being made by the National Commercial Gas Association, to ascertain the number and total horsepower of gas engines operating on artificial gas, will show the extent of the new business secured in the "Power" department.

Natural Gas.

Competitive conditions, of course, were somewhat different in natural gas regions. In 1874 when natural gas was first used in manufacturing it at once demonstrated its tremendous possibilities. It was carried in pipes 18 miles to an iron mill in Pittsburgh, Pa., and used under 12 boilers, in 9 heating furnaces, and 28 puddling furnaces. In 10 years from that time one iron establishment alone used a million cubic feet an hour. Natural gas may, therefore, in this brief review, be left to continue its almost uninterrupted and unlimited progress. The new business agents will go on reaping marvelous results from their discoveries of new outlets and appliances.

Territories Once Supplied with Natural Gas.

In places where the natural product has been exhausted, and the adoption of artificial gas has followed the reckless misuse of the natural supply, the sales departments have had to face probably the most complicated problem in the industry. Dissatisfaction following continued extravagance, the lower calorific value of manufactured gas, the higher cost, and the public ignorance on the whole subject, have rendered educational work for a time the most important part of the sales manager's efforts. Public exhibits of appliances, actual demonstrations of utility, careful use and economy, a systematic canvass of homes and industries and instructive literature have been the effective methods adopted.

Expositions.

Of all the more national expositions that have taken place since the exhibition at the Crystal Palace, New York, in the early '50s, such as those of 1876, 1885, etc., the great events that have influenced the development of the new business department were those held in Madison Square Garden, New York, in the spring of 1897, and the ever-to-be-remembered Exhibition and Convention of the National Commercial Gas Association, in Chicago, December of last year. These astounding assemblages of gas using appliances brought the representatives of the commercial department to a fuller realization of the amazing development of the gas business.

Solicitors and the Card System.

Although it may be stated that no two companies have found it advisable to adopt exactly the same methods of selling gas and appliances, it will be conceded that the employment of thoroughly instructed solicitors, operating the card system, has achieved the most satisfactory and profitable results. An example of the card system is best described as a file of standard size cards containing the name, location and occupation of every resident along the lines of the gas mains, and showing exactly, by census and future post-

ings, the extent to which gas is used, thus indicating the possibilities for further busines on each subsequent visit. The classification and separation of the cards have been important features of the card system. By this means the soliciting work and the advertising literature have been concentrated, thus saving time and producing quicker results.

The method of payment for soliciting work has varied according to the size of the company and the scope of its operations. Many are of the opinion that a flat salary has had a tendency to keep up

Residence — Classification

No. ..... STREET ..... FLOOR

OCCUPANT ..... BUSINESS .....

OWNER OR AGENT ..... ADDRESS .....

Present Lighting?	Welsbach or Open Flame?	Present Heating?	Good for Credit?	Deposit or P. P?	Service in?	Piped for Gas?	Gas Fixtures in?

No. Gas Arcs Used?	Stove Line?	Gas Range? What kind?	Water Heater? What kind?	Hot Plate? No. Burners?	Portable Oven?	Radiator or Heater?	Gas Appliances?

Date ..... 190 .....

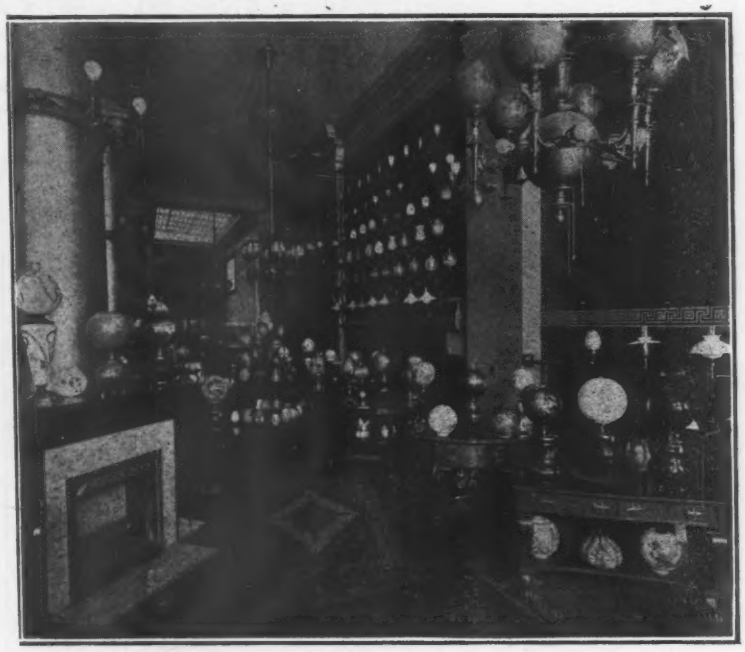
Canvasser .....

MOVED TO .....

Form 28. 5M-9-'06

Sample of Solicitor's Card.

only a fair showing, and that the "salary and commission" plan has been productive of the largest percentage of undesirable business. A plan worked out with remarkable success, in a city which has shown one of the highest averages per mile of main, was the payment of a fair salary and the adoption of a system of periodical prize givings for the best work performed, with an increase of salary to the prize winners. In one of these later contests, and at a period when the city in question had only its "gleanings" to harvest, a prize winner sold 200 gas ranges from March 16 to June 1. For the prize method it may also be claimed that the results have been produced at the lowest new business expense. The morning talks of the sales manager, and the educational and social meetings of the men, have contributed largely towards the building up of that conscientious enthusiasm which brings success



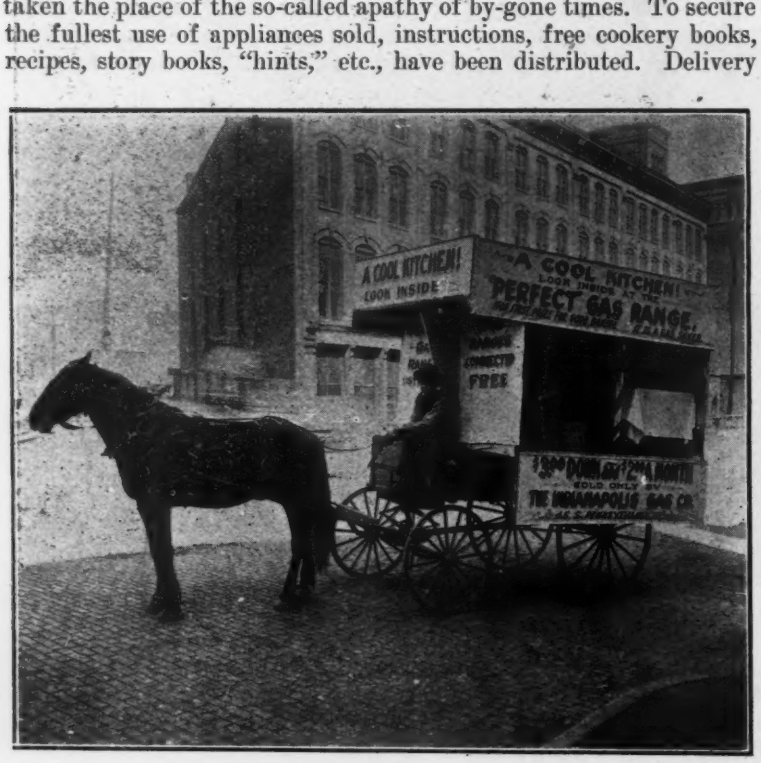
A Good Lighting Display.

and reward; and the highest gains in loyalty and sales have been found in the cities and towns where these meetings have been recognized, encouraged and supported by the general managers and directors of the companies.

The Original Providence Gas Company's Appliance Showrooms.

Advertising and Displays.

The contrast between the show of batswing burners and drum heaters in the old gas offices, and the pretentious exhibits of brilliant illuminations and other attractive features of the modern sales room of to-day, is another evidence of the remarkable expansion and present scope of the gas industry. Advertising departments; displays in schools and public halls and at public conventions; model rooms of properly lighted and furnished homes; window displays and elaborate decorations to attract customers, have taken the place of the so-called apathy of by-gone times. To secure the fullest use of appliances sold, instructions, free cookery books, recipes, story books, "hints," etc., have been distributed. Delivery



Advertising Wagon.

and peddling wagons have been made as showy as circus cars; newspaper space has been used liberally; advertising by mail with follow-up cards and reminders; announcements on the monthly gas bills and large and alluring spaces on the bill boards, have been utilized to advantage; and that 20th century avalanche, the 5-cent picture show, and the theater curtains have been made the instruments of placing suggestive gas pictures on the retina of thousands of receptive eyes. "Cook with Gas" has even been scrolled on the

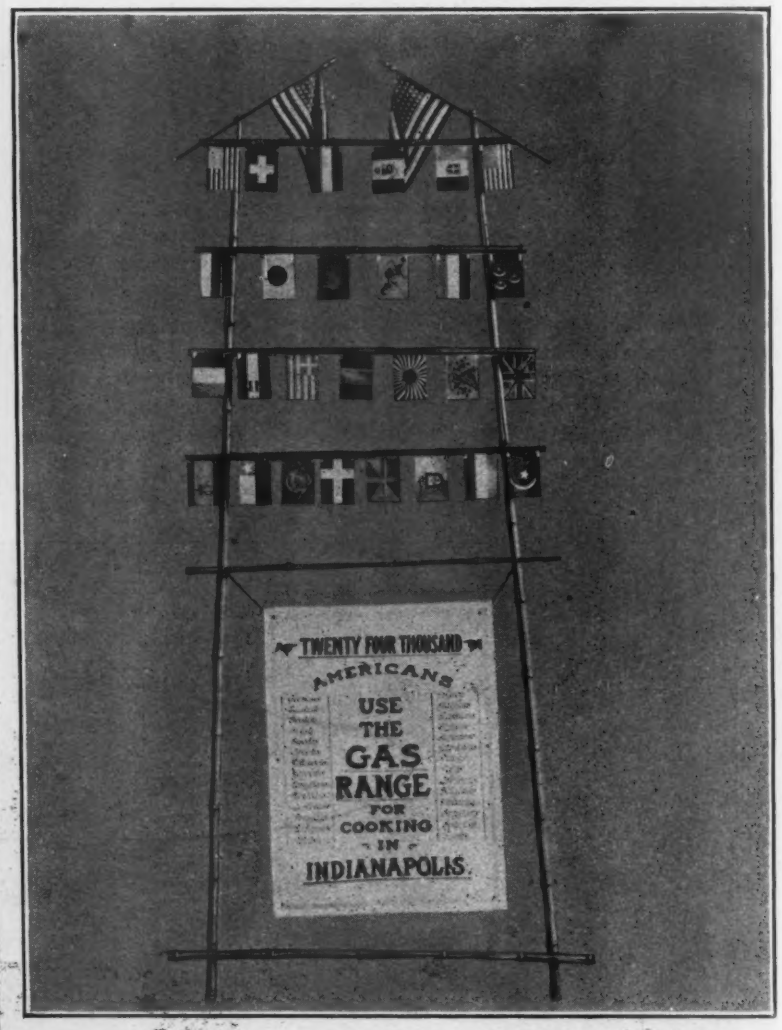
Men in White Uniforms Delivering Gas Coke, Rome, N. Y.

ice of the skating rink by a professional engaged to perform the magic words. The camel in the circus parade has been confiscated to tell the appropriate tale that he can go many days without water, but that the enchanted crowd, hungry from long waiting, and with the fire out, can't do without a gas range. The psychology of advertising has become a scientific section of the New Business Division. In this connection the adoption of white uniforms fc

the men who deliver "Genuine Gas Coke" has had its influence. Empty houses have been "tagged" for water heaters, ranges and fixtures. Chickens, newly hatched in gas incubators and gas range ovens, have been displayed in show windows. The arts and sciences have been called upon to illustrate the attractive economies of gas consuming goods. Music has been invoked to sing the song of the gas range.

"How sweetly the steam from the Kettle-spout whistles,
How faintly responsive the Sauce-pan's refrain;
How gaily the Oven the dainty dish sizzles,
And sings the glad maid an accompanying strain.
The notes of a Gounod, the Marches of Sousa,
Nor R——'s band in its happiest mood
Can vie with the music that's heard when you use a
Melodious gas range for cooking your food."

In one cosmopolitan city the use of small national flags has shown the foreigner that his countrymen here are using gas ranges. Applications for gas service, and other literature, have been translated into many languages. Circular letters, circulars, pamphlets, pro-



"Flagging the Foreigners," Indianapolis, Ind.

gram advertisements, testimonials from prize-winning letters, wagon signs, floats in street parades, picture postcards, and many other schemes go to make up the stimulative history of gas publicity.

Selling Methods.

In selling gas ranges and other appliances the easy payment plan has been almost universally favored. On the average about 70 per cent. of the sales have been made on the instalment basis. Where the contract or lease has been demanded there has been a surprisingly small loss on time sales. In some cities the plan of co-operating with furniture houses, dealers in coal and oil stoves, etc., has met with considerable success. In Indianapolis this idea has been extended to embrace storekeepers, plumbers, etc., in all parts of the city, who sell the Company's ranges and other appliances as "Agents." Patrons have considered these Company branch agencies a thoughtful accommodation and the proprietors of one newspaper have placed a gas range in the newspaper office and received orders "on commission." The gratuitous articles on gas, published almost weekly by the editor, have helped to bring goodwill to the Company. In some cities, notably Rochester, N. Y., the Gas Company has so far earned the good opinion of the editors

as to be privileged to write business bringing articles in the daily press. In one city grocers and their newspaper have been brought into friendly co-operation by giving them free recipes occasioning the purchase of the grocers' commodities, and the use of gas. Fish dealers have been made auxiliary aids to the sales department by means of recipes on "Planking Fish," and selling to them at cost hickory boards for planking. This scheme has added to the sales of fish and made the broiling oven more popular. The friendliness and goodwill of labor organizations have been secured by fair policy talks in the union organs. The woman instructor, who visits the homes, has produced incalculable results. New York, Chicago and other cities have organized staffs of these instructors. No longer in these places are gas ranges made the "receptacle for old boots" or used as refrigerators as in the earlier days. The instruction given in the office during the days of the month when the gas bills are paid has secured the intelligent use of the gas range and prevented those complaints which the more youthful gas companies tried in vain to cure. The sale of the triple and double saucepans, which cook two or three dishes over one burner, the toaster, the iron heater, etc., have emphasized the willingness on the part of the gas company to help its consumers to avoid injurious extravagance in the use of gas. "Matches are cheaper than gas" has surely made money for the match makers, and given to the public striking evidence of the gas company's square dealing policy.

Outdoor Booth, Indianapolis Gas Co.

Outdoor Booths.

One of the more novel and profitable means of reaching large assemblies of people has been the exhibits and demonstrations in booths at the State and county fairs, and at local ventures of a crowd producing kind. This outdoor advertising idea is not peculiar to Indianapolis, but in that city, especially when the "Child Cook" was, in show parlance, made the "stunt," fully 6,000 people on an average crowded around the booth each evening. Toasters and other appliances, offered for sale by volunteering ladies, found ready purchasers, while the gas range and other items of the outfit were exhibited and sold. The Company illuminated the grounds and the booths with Welsbach gas arc lamps, and gained in the lighting field brilliant publicity and new customers.

Souvenirs.

There is little evidence that the adoption of the souvenir idea dates far back into the past 50 years. The oldest records show only an occasional offer of the "attractive bribe," in the shape of tar or some other residual of the works. Modern developments of this plan to please and gain customers have occasioned the distribution of innumerable souvenirs, and everything imaginable, from a fan for the ladies to the sun-bonnet and winter blanket for the horses, has been devised and given away. Calendars, buttons, blotters, match cases, match strikers, pan-lid lifters, bill files, thermometers, mirrors, spoons, bookmarks, needle packages, money box safes, lettered soap, rulers, pencils, puzzles, pin and ash trays, wagon umbrellas, art plates, wallets, asbestos mats and a thousand-and-one other things, each good in its way, have been presented to gas consumers or "prospects." One of the more novel and serviceable souvenir ideas, originated by Mr. Carl H. Graf, General Manager of the Indianapolis Gas Company, secured not only good advertising and goodwill, but augmented the gas consumption. This gift to the first 7,000 consumers who paid their bills consisted of a pair of steel gas pliers and three "Bray" burners in a neat cardboard box. To the customers who came too late to secure the pliers, smaller boxes containing "Bray" burners were presented.

Industrial Appliances.

In the department of mechanical appliances there has been probably the most impressive proof of prodigious expansion than in any other branch of the artificial gas industry. The application of gas in the industries has opened up markets which, even after they have been vigorously worked during a portion of the past 50 years, and systematically developed in the last decade, appear to be without a limit. The night load at the gas works has been equalled and in some cities exceeded by the daylight demand. The constructive genius of mechanics and the inventive suggestions of the commercial agents of the gas companies have made gas appliances responsible for much of the progress of the factories and workshops of the country

Souvenirs Given with Gas Ranges, Indianapolis, Ind.

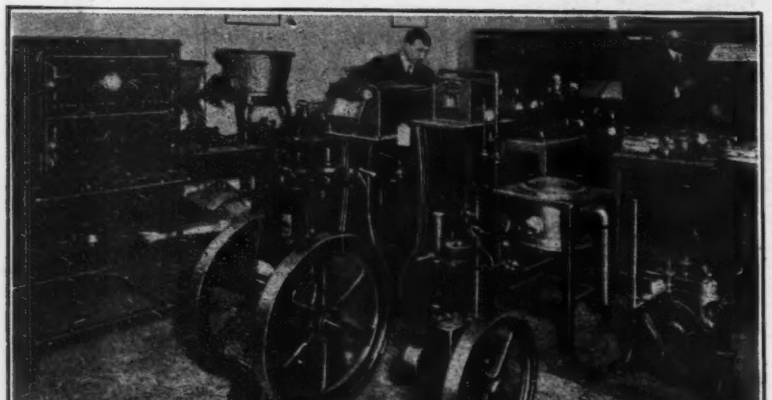
and materially helped the growth of the national commerce with other lands. The vast variety of industrial appliances that have been developed in the various States have been summarized, and this comprehensive list, though perhaps not exhaustive, will offer a serviceable and historical record at this opportune period. Among the more peculiar victories for gas, the asphyxiation of dogs, in the dog-pound at police headquarters, and the scientific culture of bacteria in gas incubators may be cited to show that our electrocuting competitors have been left far behind in these new business specialties.

Brethren of the New Business Department! let us listen seriously to the words of an expert in this great industrial field, Mr. Wm. H. Allen, who says: "A long experience of 20 years has brought me in contact with about every line of manufacture known in the industrial world, and I have failed to know of one where gas cannot be used, not only satisfactorily, but along economical lines and produce better results than where other fuels are used."

Balloons.

The prediction made by far-sighted competitors that "gas would be up in the air some day" has literally been verified. Balloons have been well-established on the list of gas consumers. In the recent balloon ascensions in Indianapolis, one balloon required 100,000 cubic feet and another 40,000 cubic feet of gas. Two

aeronauts, seated in a large automobile, ascended with the big balloon and passed safely over the city, to the astonishment of the population. A novel advertisement followed, showing the important part which "gas" played in that and other business ventures. Four miles of 6-inch pipe, under 50 pounds pressure, have now been run and paid for to supply the gas bags for the monster balloon races in the same city on June 5th. This event will relieve the gas company of over a million cubic feet of gas.



Industrial Appliances.

CONCLUSION.

In concluding this very brief and imperfect retrospect of half a century of vicissitudes and achievements we would thank the sales managers who have contributed data for this article and also acknowledge gratefully, on behalf of every representative of the new business branch of the gas industry, the incalculable aid and stimulus received in the past from this JOURNAL. In rising to wish the JOURNAL continued prosperity let us "dedicate ourselves anew to the true commercialism that is worthy of our best American ideals," remembering the unquestioned probability that, during the coming 50 years, there will be far greater developments in the gas business than there have been up to now. Older ideas must give place to more advanced methods. What has succeeded in the past will not show equal success in the future. New appliances, superior in adaptability, efficiency and economy, larger ideas, higher training of salesmen, and the lower cost of gas manufacture and distribution, following new discoveries and processes, together with contemporaneous growth of competition, must all inevitably tend towards speedy progress and ultimate perfection.

Growth and Value of Demonstration Work in the Household of Gaseous Fuel.

[Prepared by MRS. HELEN ARMSTRONG, Chicago, Ill.]

"The great thing in the world is not so much where we stand, as in what direction we are moving."—*Oliver Wendell Holmes.*

It would be very difficult to properly estimate the advance made in the use of gas as fuel during the last half century. That the progress made has been enormous there can be no question, but its possibilities have by no means as yet been realized. The increase in use of gas ranges seems marvelous, when figures are shown, but is not really so when one considers the comfort and convenience as contrasted with coal or wood. Much of this is due to the self-evident advantages of the gas, but great credit should also be given to the educational work done throughout the country by practical demonstration.

It is no exaggeration to say that not 20 per cent. of the women cooking with gas to-day know how to do this to the greatest advantage, both regarding results and expense. Few, indeed, understand the principles involved in broiling or roasting, two processes done to perfection with gas when properly managed. It is no uncommon thing to hear a woman say, "Oh, yes! I like the gas range for some things; but when it comes to baking, give me my good, old cook stove." These women simply lack the knowledge required to manage the range properly for baking purposes.

The comparative cost of gas as a fuel is not generally known to housewives, as they can rarely tell what they pay per month for wood or coal. It is bought in quantity and no track kept of the amount used, so that little idea can be formulated as to its actual cost by the week or month. Women have the reputation of being poor financiers; this is quite natural, indeed. How can they be expected to know how to use money, unless they have the chance to use it? On the rare occasions that they have funds to use freely they are very apt to do this indiscreetly; but what man will deny that, when it comes to a financial crisis, no one is more willing or unselfish in economizing than the housewife and mother? As the woman who administrates her household affairs practically spends the money her husband earns, whether she ever has a dollar of her own or not; she may be his greatest help or hindrance to financial progress. Does she not earn the privilege of every comfort and convenience within his means? The modern housewife has so many calls upon her time and strength that she is surely entitled to any legitimate means of simplifying the household labor. No single article in modern times has done more toward Home Making, than our dependable ally, the gas range. In this day of questionable domestic service, the range has made it possible for a woman to prepare the meals for her family without becoming simply a household drudge. To the female mind the word Economy usually applies solely to money. She does not appreciate that the true meaning of the word means wise expenditure (whether of time, energy or cash), but rather thinks of it as implying *stinginess,* and "going without things." In order to save a few dollars she will often expend undue strength, perhaps crippling herself temporarily, and thus spending eventually many times the sum originally *saved.* To insure having work done to suit her she will sacrifice her own self rather than depend upon inefficient service. We knew a farmer's wife who had a most strenuous summer and yet insisted upon personally attending to all the varied household duties. Some one asked her why she did not keep a "hired girl" (for in the country they still use that term) and she patiently replied, "Perhaps in the fall; if I am stronger, I will."

All of this leads to the point that the gas range is our greatest

means of reducing the labor in the home, and that education along these lines, though well begun, must be pushed with vigor and intelligence. Think of the number of gas ranges within our own knowledge which stand in the corners of kitchens, tried but occasionally, looked upon as a useful adjunct, perhaps, but in no way demonstrating its own capabilities—rarely used, often abused! Of what value is it to a gas company to install ranges, unless same are to be utilized? When these ranges are placed, the women using them must be instructed as to proper regulation for various kinds of cooking. Such information must be furnished, too, by practical demonstration, so much more forcible than mere words.

Mr. W. J. Clark, so long with the great Consolidated Gas Company, of New York, has had exceptional opportunity to judge of the needs and advantages of such training, and his opinion among the gas fraternity carries much weight, hence this extract from a recent letter of his is worthy of quotation: "We feel that we have only just begun to realize the importance to the gas company of maintaining a competent corps of educators, and do not think that the field is in any way covered as yet, particularly as the matter of kitchen help is so unstable. I believe the day will come when this work will be more fully appreciated by gas companies generally, and the time is ripe for a systematic education which will gratify women to take up this important work for the gas industry." I like the word *educator*. It sounds a little like a certain brand of health crackers to be sure; but that is better than *demonstrator,* which instinctively reminds one of the glib baking powder and cereal persuaders at the corner grocery. Won't some clever gas man coin for us a word which will fitly describe the trained woman who can help the housewife in a thorough understanding of her gas range?

When the American Gas Light Journal invited me to write something of the history of demonstration work in this country for the past *50 years,* I fancied there would be some available data from which to secure facts for the paper. Inquiries, however, show there is very little in the way of actual record, so the natural inference drawn from the request is rather startling. However that may be construed, with experience so varied in both character and location, enough may be compiled to partly cover the ground. The credit for the first properly equipped gas appliance stove seemingly should go to the Providence (R. I.) Gas Company, at the suggestion of Mr. A. B. Slater, Sr., 1884. The illustration shows the scale on which it was conducted.

Among the first to do this public demonstration work were Miss "Jenny June," Miss Juliet Corson, Mrs. S. T. Rorer and Mrs. Gesine Lemcke. All had a large experience in New York City, and their work proved very effective, both in local lecture rooms throughout the city, and later in the Harlem Opera House, where large audiences were instructed. At about this time, too, was held the large exhibit in Madison Square Garden, where some interesting contests were shown, such as preparing a 6-course dinner in 45 minutes on the gas range.

Some years later the Consolidated Company opened a showroom and lecture hall on 23d street, and here I spent one season, giving lessons daily and spending some time also in instructing a corps of women employed to do inspecting. This was the first systematic work that had been attempted in training the people who made "follow-up" visits, and proved quite practical. Since then these women have done an immense amount of missionary work, visiting some 20,000 homes each year. They instruct in the safe and economic use of the appliances, and investigate as to their proper installation and efficiency, under the able direction of Mrs. Shuart.

Similar work in Milwaukee, and later in St. Louis, on a larger scale, was done about the same time by Miss Mary L. Clarke, a most painstaking and indefatigable worker. She had about 40 women who not only did the inspection work, but also gave regular cooking lessons in various sections of the city, as in New York, reaching all classes from the settlements and industrial schools, to the church and social organizations. Under the jurisdiction of Mr. J. C. D. Clark this education of the masses was pushed most vigorously for a number of years. Miss Clarke retired some time since, and is enjoying a well earned rest in California.

Denver is another of the large cities where this sort of advertising has been persistently advocated, and the gas office there has its own lecture room for this purpose, as had Pueblo also.

Among the men well-known to the gas world, who have made this branch of advertising a recognized feature I would mention Messrs. E. G. Cowdery, H. L. Doherty, Thos. D. Miller, Paul Doty, J. R. Huntting, Phillip Cross, S. P. Curtis, Philmer Eves, also our friends all through the United Gas Improvement Company, the American Gas Company, and, in fact all the concerns known as parent or operating companies.

These men have also appreciated the possibilities resulting from the public school, domestic-science work and have most heartily cooperated with these bodies in installing gas appliances, encouraging prize bakings, essays on gas cooking, etc. This important branch will eventually become a part of the curriculum in all public schools, and the provident gas man to-day is making every effort to secure this for his own town.

The public demonstration in earlier years was usually just a showing of how to manage the range while preparing a meal. Little attention was given to fuel consumption or to the economic possibilities; neither was time spent showing how to care for the range, and keep it in good working order. Oftentimes women doing this work were neither trained through experience nor prepared by education, and of natural qualifications were quite deficient. To-day we look for graduates of domestic science institutions, with a thorough working knowledge of their theories, and of desirable personality. Not that *looks* cut so much figure, but to deal satisfactorily with the public (and women at that), such an instructor must be of pleasant manner and able to interest and convince her hearers. Even if of fine appearance, a fluent talker, and a good cook, all is of no avail if she be deficient in tact.

The value of demonstration work is often a disputed question, and to the gentleman from Missouri I would like to present a few points, perhaps in a different order of precedence than is usually followed. First of all, let me say, however, that "you can't make money without spending it." We all know this, but we like to ignore it; and the company who goes into this sort of advertising should appreciate that, if done at all, it should be done right. If hampered for funds, wait, or do something else; but don't, for a matter of a few dollars, run the risk of "falling down" in any public scheme. Women are critical creatures, and a teacher who isn't able to "make good" will earn their most caustic scoring, incidentally reflecting upon the judgment of the gas company. Their appreciation, however, is most fortunately in equal ratio, so that the credit received from a satisfactory demonstration is indeed gratifying.

First.—The most potent argument in favor of demonstration lectures is the pleasant feeling which is generated among customers. Public opinion is hard to fight, but easy to please, and women who receive practical instruction in an entertaining way, spread the gospel for the gas company. Women will talk; and, when they are provided with a pleasant topic, are quite as willing to enhance upon its merits as to run down their neighbor's housekeeping. If they have a really good thing given to them, it is a subject of discussion for days and weeks to come. They are indebted to the gas company for this and recognize it by a more kindly attitude. The pose of public benefactor, for the gas company, is a new one, but it is vastly becoming. Try it on, in a good light!

When confidence is won, it is easily kept by fair dealing, and in no one way can criticism of the corporation be more effectively disarmed than by giving the female element something really worth while. Perhaps it may seem that this will only be a temporary influence, soon forgotten. The contrary has been proven many times; but one illustration will suffice. Last season it was my pleasure to fill a fortnight's engagement in Nashville, Tenn., a city which I had not visited for six years, but had given two courses there previous to 1903. Imagine the satisfaction of the Gas Company when we greeted an audience of over 500 the opening day. They had not forgotten!

The substantial future of the fuel gas business lies in its becoming the cooking medium at all seasons. It has been a great mistake to exploit gas as a warm weather fuel. Gas men all agree that demonstration lessons on "cooking with gas" should by no means be confined to spring and summer; but where are the companies with the courage of their convictions, that will do this in the fall, showing how the gas range may remain in use all winter? By the various means now devised, through coke heaters, furnace connection with hot water for the kitchen, and the portable gas heaters, such work could be made most valuable and practical.

Second.—The education of the women in range economy and its varied uses naturally follows the molding of public opinion in its favor. The practical working knowledge of the range works to the equal satisfaction of the cook and the company. The former secures satisfactory results, the latter sells more gas. Quality counts, and the woman who attains perfection in cooking with gas will find little fault with the expense. If she, too, has learned

the various economies possible, as should be a part of this instruction, her bills will be more nearly normal than when gas is used without thought. The ease in management and perfect outcome are great incentives to the watchful listeners. A woman recently said to me, "I don't do any of my baking, and I don't *want* to; but if I keep on coming here you'll have me doing it yet, for my fingers itch to try doing these things after I see them made." Some people think they can cook with only fingers, foodstuffs and fire—the most needful ingredient is intelligence.

I have known women so ignorant that they were afraid of a gas range, and so used *gasoline!!*

Third.—A great advantage in cooking demonstrations lies in the fact that at these lessons women often learn by contrast that their own ranges are not producing proper results. This may be due to the cook, the stove itself, its misuse, or improper adjustment. Existing conditions are brought out through discussion which would not be reached otherwise. If a gas appliance does not "work," the housewife tells her friends and neighbors, but often neglects to notify the people most interested, the gas men themselves. The business manager will get in touch with local conditions more quickly than he might wish, if he isn't a hustler, through a week or two of "Cooking School." One woman went right over to the gas office after a lecture and wanted her meter put into the kitchen, for she could see at the lesson, by having the meter near, how a much better flame is secured! A little learning is indeed a dangerous thing.

Fourth.—As a last argument in favor of the public demonstration I mention the selling of ranges, or the securing of new consumers. Most gas men place this as a first consideration. It has its place; but it is far more important to the company that the women who have ranges use them, and also use them to their own satisfaction. Many consumers with moderate bills—rather than a few with enormous ones and the masses with accounts too small to pay for the bookkeeping. This kind of advertising will sell new ranges to many who have an old-style outfit and to some who have none at all. It will show the improvements in various kinds of ranges and thoroughly demonstrate the convenience and comfort found in using an up-to-date article. No matter how fully a town is piped, canvassed and equipped, there will always be room for new business. So long as advances are made in range constructions and an increase in gas appliances for our homes, there can be no limit to the business of a progressive company. It is like the case of the cook who was asked how she liked her place: "Well," she said, "it's like this; if you do a thing right they keep you doing it, and if you don't they fire you. So what's the use?"

Methods of Advertising Cooking Lessons.

The means devised for the purpose are many, their value being based upon local conditions. Newspaper space "ads." and reading notices have their use, the latter especially, if well placed and to the point. Display cards in windows about town, posters and street banners all reach certain people; but the personal invitation or notice is most successful. These may be sent out with gas bills, mailed to individuals, or delivered at the homes. Both messenger boys and mission men have been employed for this purpose with good results, and at a nominal cost. The great point is that each housewife receives a personal notice. In this way she is informed of the place and hour of the meetings, with some outline of the course to be given and an assurance that the work will be practical and questions welcome. Every sort of place has been tried for this: The portable tent, handy, but almost too dependent upon the elements; the vacant store, convenient to the public, but noisy; an opera house, excellent in some respects, but the audience too far from the speaker to invite free discussion—an important feature. Where the gas company has its own hall the arrangement is best of all, but lacking that, the smaller public rooms, as lodge halls, Y. M. C. A. and club buildings answer admirably. Through church societies, where time permits, many people may be reached by visiting the different organizations in their own parlors, and a bit of local pride is an incentive to generous representation.

Local Dealers.

So far as it is possible, co-operation with the local stores in fitting up the platform, is to be advised. Almost without exception, they are ready to loan the needed furnishings outside of gas appliances, and the working equipment which the instructor usually possesses. In this way the cost is small; but more important is the fact that the dealers have an interest in the affair. They will help advertise, and town people like to feel that their own shopkeepers are "in it"; this more especially in small places, where pride is as great, in proportion, as business is small. It is possible, with the right sort of instruction, to reach both the intelligent class and the ignorant; but at the outset one can be sure of a generous sprinkling of "good cooks." They always go to cooking school. Being already capable, they appreciate their limitations and wish to learn more. "None are less eager to learn than those who know nothing." The stupid, the indifferent, and the self-satisfied are equally the despair of the teacher, but when interest is aroused and conviction carried the reward is commensurate with the effort. Lessons cannot be too practical, nor can directions be too explicit. Too much in a lesson arouses confusion, while elaborate or expensive dishes arouse criticism. Simple dishes accomplish wonders when deftly prepared. Broiling must be illustrated early-and-oft. Roasting and baking of various sorts require accurate instruction. Oven dinners develop unknown possibilities in gas economy. Meter reading and cost of daily consumption have a value too, though it is hard to convince the skeptical that some special contrivance is not employed. Many questions will be asked if they are encouraged, and they should be, for often some points will thus be brought out that otherwise would not be mentioned. Repetition may be tiresome for the speaker, but it will be necessary so long as women are inattentive, slow to grasp or "late to school," and some of each class are always in evidence. The trouble maker sometimes appears, ready to ask untimely questions, tell how she does, and if possible, catch the teacher on some quibble or in a contradiction. Patience is part of the game. Often by seeming to appreciate her interest, the embryo enemy is made a friend, her very attitude being turned to good account and her co-operation is secured. "One smile invariably inspires another."

Much general information on household topics can be interpolated during these lessons to the satisfaction of the housewife. Recipes are the smallest part of the information obtained in any kind of a cooking school, whether for gas or culinary instruction alone; but the printed forms give women a working basis for the experiments which surely follow at home. An instructor engaged to demonstrate the cooking with gas in a certain section was asked if she did not prefer to have the recipes printed. "Oh, no," she said, "I would just as soon dictate them to the ladies; it helps fill the time!" There's an example of a progressive teacher; while the gas company pays the bills. The specific instruction on the range includes explaining general construction, principles of the circulation of heat, adjustment of air mixers, how to light, use of various top burners, also upper and lower oven, the proper flame, care of range surface, burners and oven, how to remove and avoid rust, grease and dust, with regulation of heat.

Practical Instruction, Points in Economy of Gas.

1. *Expense.*—In actual cost it compares most favorably with other fuels, whether coal, wood, oil or electricity.

2. *Efficiency.*—For perfection in results it has no equal. With a certain quantity of materials, combined in a certain way, and the application of a certain amount of heat, results are certain. Women need not lay failure to luck when the gas range is used. It lies in faulty usage.

3. *Cost of Range.*—The initial cost of a gas range is much smaller than the cost of a cook stove of any reputable make. Even the modern cabinet gas range, of high grade, is modest in price. As in all lines of purchasing, quality pays in the investment, both in character and length of service.

4. *Size of Range.*—A double-oven range is less expensive to operate, makes all kinds of cooking possible, and should *always* be advocated. Anything else is simply a makeshift.

5. *Size of Oven.*—The difference in gas consumption between a small oven and a larger one is so slight as to be scarcely appreciable in cost. Nothing less than an eighteen-inch oven gives a perfect cooking vehicle. The occasional requirement of the large oven, even in a small family, emphasizes this need, and without it the cook is sadly handicapped. When in use at all it should be used to fullest advantage.

6. *Cabinet Style.*—The comfort and convenience of the cabinet range are so apparent that we only wonder that this truly ideal combination has not been pushed with greater activity. Work with the broiler may be done both with ease and dignity. However devout a housewife may be she cannot enjoy broiling, on her knees.

7. *Saving of Time.*—We find the range a time-saver, both in the required waiting for proper degree of heat (whether for boiling, baking or broiling), and in the actual time needed for the cooking, to say nothing of time spent in watchfulness to maintain even temperature.

8. *Saving in Food Values.*—By the absolute evenness of heat made possible by use of gas the nutritive properties of foods are retained, a great factor in food economy. Flavors remain in the food, instead of being dissipated.

9. *Weight of Meats.*—Roasts cooked in the gas oven, through the constant motion of air and its moisture, lose less in actual weight by so cooking, than when baked in the closed oven of a coal or wood stove.

10. *Saving in Labor.*—The labor saved by use of gas covers many phases.

First: Through purchase and storage of fuel.

Second: Through handling and caring of same.

Third: Through energy expended in building a fire, plus a precious half hour nap.

Fourth: Through energy expended in care of fire, maintaining proper degree of heat.

Fifth: Through energy expended in care of range; blacking and unladylike language.

Sixth: Through energy expended in care of kitchen.

Seventh: Through energy expended in care of utensils.

Eighth: Through laundry work.

As the gas range makes no dirt, neither utensils nor clothes are soiled. This, while reckoned as a labor saver, to the intelligent housewife means a great inducement, not only from economy, but in a pride in her kitchen. She may do her cooking dressed suitably to see her friends or sit down with her family; and her kitchen may be equipped with choice utensils which will last a lifetime, while using gas.

11. *Cooking of Vegetables.*—It is possible to waste much gas in the use of top burners, if not properly understood. All that we can utilize in the boiling of vegetables is a heat of 212°; beyond that there is simply greater evaporation; no increased softening of tough fibre; nor saving in time. When gas burns up around the sides of a utensil there is also waste of fuel. When these points are emphasized, a great saving *may* be accomplished.

12. *Gas Consumption.*—One of the greatest economies with gas is that it is only burning the same length of time required for cooking. Our top burners are hot as soon as gas is ignited.

12½. *Time of Cooking.*—An oven burns gas from 5 to 10 minutes in advance to heat the oven thoroughly; but as we can also turn the gas out the last 5 or 10 minutes of cooking (the heat maintained being sufficient for completion) we actually burn gas the same number of minutes as the article cooks.

13. *Sanitary Conditions.*—The point has been made that the gas range makes no dirt, thus saving labor. Much more vital, however, is the fact that where neither dust nor dirt are formed the sanitary conditions are vastly improved. The kitchen is the "laboratory of the home," the place in which the food upon which our families depend for nourishment and health is prepared. To-day we appreciate that food and our manner of living largely influence both character and usefulness; this being true, how important it is that the room where such food is made ready for us, be clean and wholesome. There are plenty of back-number kitchens for back-number cooks. The gas range is the one vital feature in the kitchen of the progressive.

14. *Comfort.*—The comfort, from the standpoint of reliability, has been suggested, but we have also the comfort of temperature; no sickly hot kitchen on summer days, so little is the loss of heat from radiation.

Wonderful gas range! On a cold winter morning we light the oven and in a short time the chill of the kitchen has disappeared and life once more becomes endurable. How cold a cold kitchen can be, in the chill of a frigid morning! Then, when summer comes, we sing the praises of the gas range. No heat, no discomfort, the kitchen always cool!

Most marvelous and adaptable, oh, gas range!

The versatility of the portable gas broiler or grill (which is seen so much in foreign countries) was rather surprisingly explained to me last summer when examining these conveniences in Paris. The enthusiastic shopman said, "Oh, madam, this is of such a convenience. You can wear it on a gas stove or either on a stove of coal."

Broiling needs more emphasis than any other single process as it is less understood. Women were not so much to blame for clinging to the frying pan when broiling was done by coal—nursing the fire some time in advance to secure the right condition; then, standing over the bed of hot coals, turning the meat constantly, in a kitchen full of the smoke and smell of fat dripping into the fire. Then came the gas range with its perfect broiler and abominable location. Would *you* care to get down to the floor whenever a piece of meat is to be broiled, exhausting yourself both physically and mentally? With the range of to-day both broiling and baking may be done with comfort, at a suitable height, and the frying pan should be consigned to the junk heap with the coal hod and shovel.

Broiling.

In their given order these points should be emphasized in regard to broiling:

1. Meat is more wholesome and finer in flavor.
2. No waiting for right condition of fire.
3. No smoke or smell.
4. No loss of fats (all saved in pan).
5. No discomfort in process.
6. No overheated kitchen.
7. No handicap to balance of range while in use.
8. No burning, if oven door be open.
9. No waste of fuel as gas can be out during last part of process.
10. With this feature at home there is no need (excuse) to go to the club, for choice steaks. [By unanimous vote of the men connected with the company this argument may be omitted].

Gas Appliances.

Space should be arranged for a display of various appliances, also a variety of ranges. It would seem needless to say that neither hot plates nor portable ovens should be in evidence; but experience shows that it must be repeated and forcibly, too. Are you satisfied to serve simply a salad or bowl of soup to the friend who comes to dine with you? Then, why sell a customer part of a cooking outfit instead of a range complete? It *may* be necessary to sell these things; but surely we need not parade them before the public.

It will be readily seen that to show these appliances and meet the customers (both possible and actual) who attend these courses it is necessary to have an intelligent and courteous person in charge, whether man or woman. Such an one will get many talking points from the lessons and use same to advntage afterward. It is only one of the many points to consider. At a series of lessons recently given in the West the only representative of the gas company (and it was their tea-party, too) in evidence had never sold a range, did not know how to light it, and couldn't tell what it cost. Naturally, immediate results were proportionate. Emphasis has been placed upon demonstration work as given to classes, etc., but the same general points apply to the trained instructor who visits the homes, meets the public in the gas office and does general utility work along range lines. She teaches the same sort of thing, realizes the actual condition in the kitchen, copes with it and comes out victorious. We need more such women. The companies who have employed them know their value. Those who have not could do so advantageously. There are not enough of them to go around, and yet plenty of clever young women are working in offices for poor wages, rather than do any work which may soil their fingers. We, who are interested heart and soul in the gas industry, must use what means we can to interest girls in this field, for that it has a future no one can question. Through the institutions of Domestic Science we may reach those who are equipped on the teaching side; the gas man must complete that training. Who will teach the proper point of view? Our young people of to-day are not willing to use their hands; book learning has been over-emphasized. They must learn that "Education does not mean an escape from manual labor but an incentive to do same intelligently."

"Uncle Jerry" in Reminiscent Mood.

[Prepared by Mr. J. B. HOWARD, President of the Gas Light Company of Galena, Ill.]

My introduction to the gas industry dates back to 1844—an early period. In the winter of 1844 I lived in the Ninth Ward, New York, and some of us boys would attend the old Bowery Theater occasionally. On our way home after the performance we often called in at the old gas works of the New York Gas Light Company, at Canal and Center streets, to get warm. Rosin gas was then manufactured at this plant. The holder (about 60 feet diameter) was situated at the corner of Center and Hester streets. The Gas Company did most of the gas fitting in New York in those days, copper pipe and brass fittings being commonly used. In 1846 I assisted in taking out from the old Astor House, New York, a large quantity of copper gas pipe for which iron pipe was substituted. Accidental explosions sometimes occurred from blowing through the old copper pipes, and two of the Gas Company's employes were fatally injured in this way.

The Brooklyn (N. Y.) Gas Light Company's works was built in 1848, and the next year I engaged to work in Brooklyn, at my trade of gasfitter, working there until I went to Dubuque, Iowa, in 1856. While in Brooklyn I became acquainted with the engineer of the gas works, Mr. J. K. Brick, and did a good deal of work for him in my line. The gas works stood near the foot of Hudson Avenue on the East River. Mr. Brick was also associated with Mr. Ira U. Stanley in the manufacturing of clay retorts, firebrick, and tiles. I believe these men were the first makers of clay retorts in this country, and the original factory is still in commission, at Van Dyke and Elizabeth streets, in the Red Hook district of Brooklyn, N. Y. I think they are now controlled by a man named Gutkes, whose business is that of a smoker of fish.

I was also acquainted with Col. Ambrose T. White, Engineer of the Williamsburg (Brooklyn) gas works, father of the immortal Captain "Harry" White. He was a fine old gentleman.

During the meeting of the American Gas Institute, in New York last October, I visited, with other members, the new mammoth plant of the Consolidated Gas Light Company of New York at Astoria, designed by that justly eminent gas engineer, Mr. Wm. H. Bradley. I shall never forget the feelings I experienced in going through the several departments of the great plant and in viewing the mammoth holder, rated to contain 15 millions cubic feet! Calling then to mind the works I had seen in New York, when a boy of 14 years, it seemed past realization that the gas business of New York had expanded so enormously, and that millions of cubic feet were going out to the city as compared with the thousands of the old works at Center and Canal! What a change! What a change! thought I. And as I contemplated what had come in 65 years, the thought came, also, that your "Uncle Jerry" is older than he thinks!

In 1856 I went West, and shortly after reaching there I became Superintendent of the gas works at Dubuque, Iowa. The annual output at Dubuque was then about 4 millions cubic feet. The Dubuque works occupied a piece of ground 49 feet front by 75 feet to 85 feet deep; this area including space for the 40-ft. diameter holder. Dubuque then had a 4-inch works. As would be supposed, the retorts were of cast iron. There was no exhauster, no station meter and no governor, except a valve, but the gas works at Dubuque at that time were typical in size as well as in equipment, of gas works in the West, and in possibly some other parts of the country, at that day. As showing that the gas industry of this country was then in its infancy, and that no one had foreseen its future nor foretold the expansion we have witnessed, I shall state the capacity and the equipment of some works in the West when I visited them in 1857, 1858 and 1859. It was the rule that no provision had been made for extensions, and as the output increased it was frequently found impracticable to obtain adjoining or contiguous land for enlargements, so it was found necessary to acquire a new site where to erect a new works. In 1857 the gas works at Saint Paul, Minn., was running two benches of threes, during the winter, and had a third bench of threes in reserve. Mr. Faben, father of the lamented Charles R. Faben, of Toledo, Ohio, was Superintendent of the Saint Paul works at that time. Minneapolis was without a gas works until several years later. The volume of gas business since attained in both Saint Paul and Minneapolis reflects high credit on the men through whose efforts it has been secured; but it certainly never was dreamed of by the founders of the gas works in those cities.

Saint Louis was running one stack of 10 benches of threes. Mr. E. G. Pratt, Engineer of the works at that time, declared he could always do better with benches of threes than with benches having a larger number of retorts.

Milwaukee, in 1858, was running two benches of fives, with a third bench of fives in reserve.

Davenport, Iowa, and Rock Island, Illinois, each ran two benches of threes, cast iron retorts, and each had a third bench of threes in reserve.

Des Moines, in 1858, was using only one bench of threes, cast iron retorts. The capital of the State was then at Iowa City.

In 1858, Pittsburgh, Pa., was using cast iron retorts, in benches of threes, and the Gas Company there was manufacturing its own firebrick, tiles and saddles for settings, something no other gas company in this country had done. Mr. Thompson was Engineer of the Pittsburgh Gas Company at that time. I remember a visit to the gas works at Pittsburgh in 1858, when I found them experiencing much trouble from naphthalene. A 10-inch inlet pipe to a holder was almost completely clogged with naphthalene. They had the 10-inch inlet open at the top so that you could look down the pipe; and it was a sight. At the end of each stack of benches stood a washer taking gas direct from hydraulic main while cold water ran continuously in washer. It was not many months thereafter that a change was made in the location of the washer, resulting in the prevention of naphthalene to a large extent.

As already stated, the gas works at Dubuque were built in 1855, and I took charge of them in 1858. I had been under instruction, for a short time previously, with Mr. Paul A. Sabbaton, Engineer of the Albany (New York) Gas Company, my tuition having special reference to the setting and working of clay retorts. Mr. Sabbaton was regarded as "The Daddy" of clay retorts. I had to set two benches of clay retorts, the retorts coming from Belgium, and besides the instruction received from Mr. Sabbaton, I had the benefit of consultation and advice from my personal friend, Mr. J. K. Brick, Engineer of the Brooklyn gas works.

In 1858 we were getting $3.50 per 1,000 for gas in Dubuque, but during the war we charged $5.50 per 1,000 cubic feet. Service

pipes, from main to interior of buildings, were paid for by the applicant. In addition we charged $5 for setting meters, and from 25 cents to 50 cents per month additional for meter rental, regardless of quantity of gas consumed. Applicants paid cost, or part cost, of extending mains to outlying districts, with an agreement that extensions made remained our property, and I remember that United States Senator George W. Jones, under such an agreement, made us a contribution of $1,000 for an extension of about 2,000 feet of 3-inch main up to his home on the hill, which extension we ran inside property lines where necessary to avoid rocky trenching.

In 1858, and up to the war, when gas sold for $3.50, labor was commonly paid $1 a day. Since those days wages of gas works hands have doubled, while the quality of gas has been improved and the price reduced over 70 per cent. Along with the reduction in price, and the improvements in burners, the gas consumer now gets over 25 times more light for $1 than when I embarked in the business. I know no other business which has made corresponding progress in reducing cost of service to its patrons.

I rebuilt the Dubuque gas works in 1864. The works were again remodeled and enlarged, in 1896, by Mr. Geo. McLean, who, when a mere youth, began his gas works experience with me, and in 1905-06, he built an entirely new coal gas plant in Dubuque on a new site having an area of about five acres. The old site at Dubuque now constitutes the water gas station.

But the gas works at Dubuque to-day bears little resemblance to that of which I took charge in 1858. Instead of a few cast iron retorts, and the 4-inch leading main, I find a retort house containing eight benches of nines with full-depth generator furnaces, five elevators, four of them hydraulic, shipments entering and leaving the works on four railroad spur tracks, one of them elevated, coke prepared for market in roller screens elevated over bins of re-inforced concrete, a well equipped laboratory providing means for all needful tests, a long line of leading main 20-inch diameter, joined to a still longer line of 16-inch, a daily output considerably exceeding the monthly output of 1858, and even holders which, telescoped as they are, do not break the contrast with early days.

The first gas stove made and put into use in this country was, I believe, made in Brooklyn, New York, in September, 1849. The maker was an Englishman, named John Powers, a brass finisher from Birmingham, England. The gasfitters and plumbers of Brooklyn were arranging for a supper when Mr. Powers met the committee in charge and told them he would make a gas stove and have everything for the supper cooked with gas. He kept his word and made the stove; and for the first time in the city of Brooklyn a good supper, which included among other things, roast beef, and three English rabbits, secured from the steward of one of the Collins Line of American steamships running from New York to Liverpool, which had just arrived at port—the steward's brother was a plumber, working at his trade in Brooklyn—besides vegetables, puddings, coffee, tea, etc., were all prepared on a gas stove. I remember the style of the stove very well. It had four drilled ring burners on top, with Bunsen flame made from one-half-inch gas pipe and two three-quarter-inch gas pipes, drilled on the side, and burning pure gas, to heat the oven. I notice a great change in the use of gas stoves since that evening in 1849. But, so it goes.

Present Day Photometrical Practice.

[Prepared by Mr. W. H. Gartley, Philadelphia, Pa.]

There should be a general feeling of relief and satisfaction among gas photometrists consequent on the announcement, by the National Bureau of Standards, that the adoption of the new international unit of light is now an accomplished fact. Bureau Circular No. 15, 2nd edition, under date of May 20th, 1909, contains the statement that

> "Gas standards will hereafter be certified in terms of the international candle, electric standards will be certified in terms of the old unit until July 1st, 1909, unless otherwise requested."

Members of the American Gas Institute, in particular, may well feel satisfied with the present situation, because of the fact that their committee's position in the preliminary discussions appears to have been justified by the final conclusions; and the gas fraternity, at the present time, finds a unit adopted by three of the great nations, including their own, which is, for all practical purposes, identical with the average of values formerly used by them. Just what change is involved will have to be determined for each company separately by sending its standard to the Bureau at Washington to be given a value in terms of the new unit; but as some pentane lamps have been sent to the Bureau, and pronounced as of 10 candle power within the limits of observation, it will be seen that the adoption of the new unit will not be a burden on the average gas company.

The former variations of values of the unit used by gas companies was due, unavoidably, to an absence of any recognized authority as the custodian of an official unit, to legislation, agreements in franchises and contracts, and the fact that the electric interests had adopted the German interpretation of the value of the candle. In England there was a lack of agreement between the National Physical Laboratory and the Gas Referees, the values given to pentane lamps by the latter frequently running as high as 1.5 per cent. more than those given by the former; but, under the stimulus of the late general movement towards exact expressions and practice, these two important bodies appear to have more nearly agreed, and there is now on the ocean coming to us a pentane lamp accompanied by certificates of both the British National Physical Laboratory and the Secretary of the Gas Referees of London, the values given agreeing by less than ½ of 1 per cent. A comparison of this lamp with some of the lamps formerly sent to this country, after certification by the Secretary of the Gas Referees, will clear up the question of how much change the new unit involves among those companies which formerly accepted the Referees' value.

With the new unit now installed, the gas companies may purchase standards, either in this country or abroad, and have them evaluated in terms of the new unit by the Bureau of Standards. Whether the Bureau will refuse to give a certificate to a standard having a mechanical construction, or which is based on principles that they consider lacking in constancy of value, remains to be seen by actual trial. It would appear clear, though, that they could not give a value to a candle since the candle must be used up in making the tests.

There are two questions regarding this unit of light that are constantly being asked: "How do we know that, since the unit is an arbitrary amount of light maintained in some multiple of that unit in electric bulbs or flame lamps in several laboratories far apart, it will remain unchanged?" The permanence of the unit is well discussed in the Bureau's circular, No. 15, 2nd edition, previously referred to, and a reading thereof will do much to allay anxiety. The second question is: "Is the new unit sufficiently grounded in scientific origin, and does it fulfill all the duties it can be properly called upon to do?" If we can answer affirmatively, we can feel secure in the belief that there will be no voluntary change of value on the part of the National Laboratories for many years to come. Unfortunately we cannot conscientiously use a full round voice in answering affirmatively; already attention has been called to the fact that the present unit is not scientifically deduced and a demand is made for a unit that can be interpreted in the different colors of the spectrum. Dr. Charles P. Steinmetz, in 1908, before the American Institute of Electrical Engineers, proposed a new method of obtaining a unit. He introduces his subject by saying:

> "Light is not a physical quantity, but a physiological effect, that of certain wave-lengths of radiation, and, therefore, cannot be expressed in absolute physical units; it must be measured by comparison with an arbitrarily chosen standard of physiological effect. * * * A radical increase in accuracy of reproduction and maintenance of a primary standard of light appears possible only by relating the standard of light in such manner to physical quantities, that it can be determined by energy measurements."

He proposes to build up a unit out of positive physical phenomena that will remain forever unchanged. He suggests the combination of a strip of blue, green and red rays from the spectrum, each having a definite wave length and frequency and combining them to produce a white light. (See American Gas Institute Abstracts; and, Proceedings American Institute of Electrical Engineers, March, 1908.)

An investigation of the practical possibilities of such a unit source will probably be investigated by the Bureau of Standards and in other laboratories. It is a promising field for investigation, and is not incompatible with the present new unit, since it would serve to place that unit value on a permanent foundation and widen its scope of use.

The pentane lamp has made its way against mental inertia and supposed conflict with those franchises and contracts that specify "Sperm candles, six to the pound, burning 120 grains per hour."

Mr. C. H. Stone, B.S., M.S., Chief Inspector for the Public Service Commission, Second District, New York, in his "Practical Testing of Gas and Gas Meters," 1909, says:

> "The pentane lamp has reached a pinnacle never attained by any other standard, namely, it is today without an opponent."

When exposed to the same atmospheric conditions the pentane lamp will reproduce the same brilliancy to a closer degree of accuracy than any other standard except the Hefner, to which it is superior as a practical flame standard because of its color, steadiness (against draughts) and higher candle power. But it is not yet a perfected instrument. We should have specifications for the construction of this lamp that will enable the manufacturer to turn out one after another more nearly uniform than Mr. Harcourt's original specifications permit. The Bureau of Standards in Washington are addressing themselves to this problem, and have secured a Congressional appropriation to meet the expense of making a close study of the causes of fluctuation in the reproducibility of the lamps.

This accomplished, the gas companies will have cause to congratulate themselves on having arrived, after many years of wandering in the wilderness of units and standards, on firm ground from which a far view into the future presents no complications. The sperm candle will have no place in practical photometry. The question of what is meant by 22 or 24 candles in any contract is susceptible of no more interpretations than what is meant by 22 or 24 feet or pounds. In each case the unit is in the possession of the National Bureau of Standards and it is their duty, upon application, to give the final decision.

It has been said, more than once, lately, that the field of gas photometry has been lessened in importance, because of the more logical qualitative measurement through calorific value. With all confidence we can reply to this that the broad question of gas photometry is now in its earliest stages of development, the most reassuring symptom being evidences of a change from a comatose state to one of energetic life. Former narrow boundaries are broadening into wider fields of remunerative, rational work. The gas companies are no less eager than in preceding generations to acquire all possible business of lighting, nor are the more progressive companies disposed to yield one inch to their competitors until their superiority is clearly proven in each case. To this end it is recognized by experienced companies that they must know exactly what their illuminating agent will do with the best lamps and reflectors in every practical problem presented. True it is that the mere candle power of the open gas flame is one small chapter of gas photometry—a chapter lessening in interest—but the gas companies will not close the book when that chapter is finished.

One company has equipped a commercial photometric laboratory wherein the illuminating effect of modern gas lamps may be studied and other records of performance of these lamps and accessories closely gauged.

The photometrist, having at hand in this laboratory apparatus for determining the mean spherical candle power, data for the polar curve, endurance tests of lamps, behavior of mantles as to shrinking, life tests, jarring tests, and the like, is able to supply to the company's illuminating engineer absolutely necessary data for an intelligent study of the customer's conditions. The illuminating engineer must occupy himself with details of other matters, for illumination is something more than a physiological effect. Apart from their scientific accuracy, some effects please while others pall. The Corinthian column has stood these thousands of years, one generation of eyes and cultivated taste succeeding another without its outlines offending—the highest example of physiological perfection of outline. These features come under the hand of the illuminating engineer, and he finds in the field competitors worthy of all he can give to the advancement of this combined science and art.

The larger treatment of illumination problems is finding ready acceptance by our fraternity, if one is to judge by the active interest displayed by gas engineers in joining the ranks of the Illuminating Engineering Society.

The new nomenclature introduced by M. Blondel, in 1893, has been tried and found good. The new practical conception of light as a form of radiant energy has revolutionized its scientific treatment, and the gas men must enter the campaign of professional illumination, of which one branch is ventilation, or be satisfied with results entirely incompatible with the real value of their illuminating agent.

Coming back to the question of simple gas photometry of the past, of measuring the horizontal intensity of flame, it is of interest to see how the old and the new are breaking apart.

In one State, having commissions looking after the quality of the gas, the calorific value is the measure of quality; but the gas companies in that State are still maintaining their photometers, and in the larger companies they are in regular daily use. The sub-committee on Calorimetry of the Technical Committee of the American Gas Institute may have something to say on the subject, introduced by Mr. Thomas D. Miller, on the relation of heat units to candle power. A formula, applicable to a built-up gas, such as carburetted water gas, may be found from which, having the candle power and candle power per gallon of oil used, the calorific value may be calculated. If so, the photometer, because of its simplicity of operation giving accurate and continuous determinations, may be the instrument used with the calorimeter reserved for checking occasionally.

In another State, having two commissions, candles are being used by the inspectors of one, while Mr. Stone has already been quoted that the pentane lamp is without a rival as a standard.

In a third State, being the longest under the inspection of a commission, candles are used without any suspicion of lack of faith.

Calorific value is logical, but many years must elapse, or much legislation must ensue, before its general adoption; in the meantime gas photometry will have enlarged its field of usefulness to such an extent that the subject should now be taught in all our colleges and it appears to have attracted the attention of some. In one college an elective course in the photometry of illuminating engineering was taken by more than half the students of the senior class last year.

The Boston Gas Supply During 50 Years.

[Prepared by Capt. Wm. McKay, Boston, Mass.]

For 80 years the Boston gas supply has been an active public concern, and for more than 50 years the company has occupied a substantial and prominent place in the public eye. Construction and demolition, invention and adaptation, industry and thought, examinations and recommendations, investigations and disputations, conciliation and opposition, argument and invective, abuse and praise, legislation and adjudication, money and intelligence, character and talent—have all contributed to the establishment of the existing Company in its present enviable position, and to a general acknowledgment of its efficient and satisfactory public service.

The Boston Gas Light Company was chartered in 1823, and was probably the oldest public service corporation in the State of Massachusetts; it was succeeded, on June 15, 1905, by the Boston Consolidated Gas Company, in which were merged the following eight companies:

Name.	When Chartered.	Kind of Act.	District.
Boston	1823	Special	City of Boston and adjacent towns.
Bay State	1883	General	City of Boston
Brookline	1853	Special	Brookline, Brighton, Roxbury & Boston
Roxbury	1852	Special	Roxbury
Dorchester	1854	Special	Dorchester & Milton
South Boston	1852	Special	Boston & Dorchester
Jamaica Plain	1853	Special	West Roxbury
Mass. Pipe Line...	1896	Special	Not limited by charter

Although a charter was issued in 1823, the first construction of gas plants in Boston was in 1828, on a plot of land on Hull Street, at the Old North Station, still owned by the Company. On January 1, 1829, the first public lamps were lighted in Dock Square, and the inauguration of this illumination was the occasion of a remarkable public demonstration, in which the Mayor and Aldermen shared, to congratulate the Gas Company and to promise them every possible assistance. Fifty years later there were in use by the city 10,000 gas lamps; the North End works had become a great plant, employing a large number of men, and exercising an appreciable influence in commercial and political affairs.

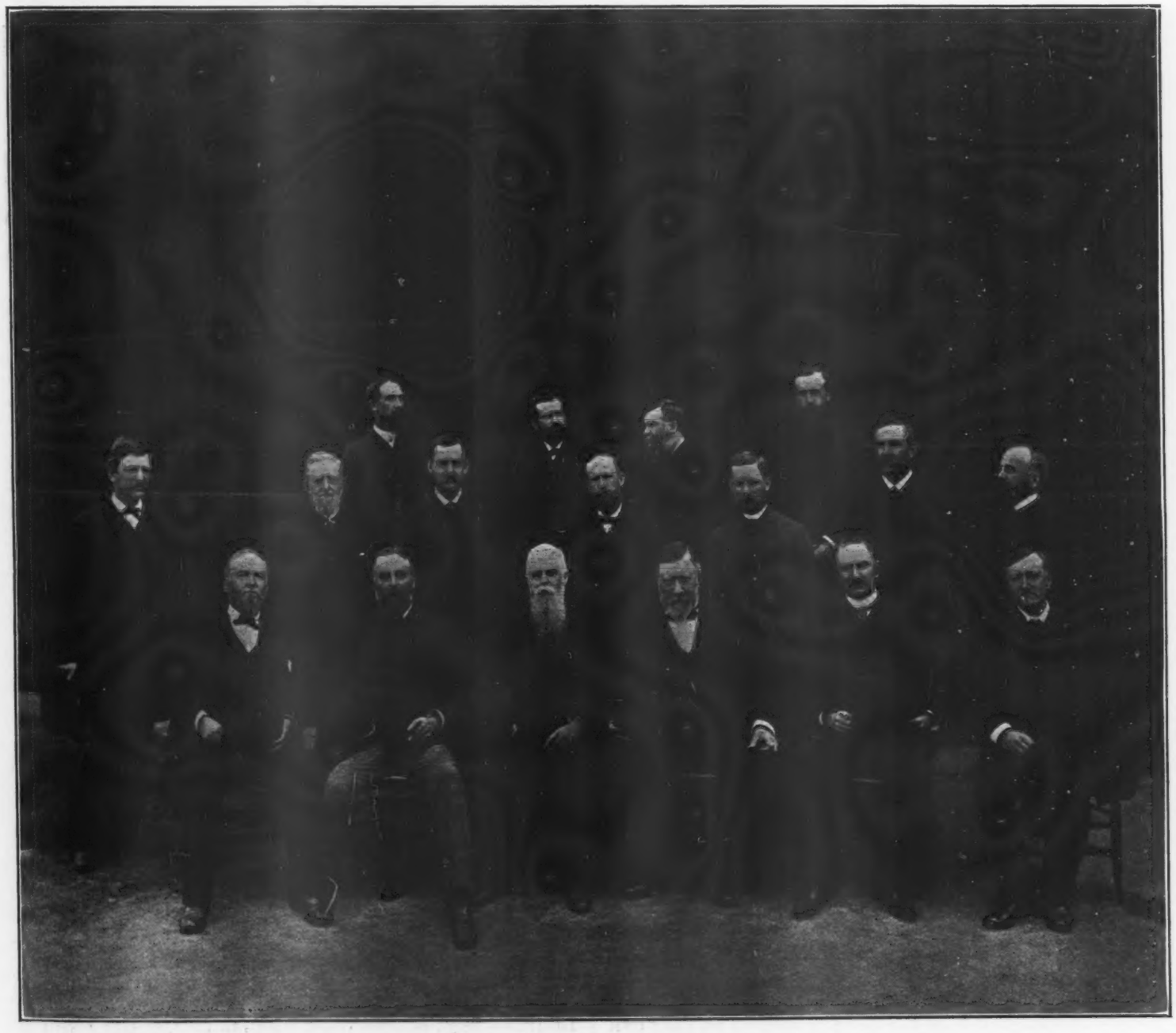
The North End works was for many years one of the leading gas works in the country. When the great chimney (still standing) was built, the Mayor of the city, the Governor of Massachusetts, and many distinguished men from all parts of the

United States attended the banquet with which the event was celebrated. The progress of the Company, as indexed by some of the important steps, is shown in the following dates:

1828. Retort House and North End works.
1833. Rosin House.
1836. South gasholder.
1849. Hull street holder.
1853. Federal street holder.
1855. Office on West street.
1857. West holder.
1862. North holder.
1864. Camden street holder.
1866. Ferdinand street holder.
1871. East holder.
1872. Began to buy land for new works at Commercial Point.
1875. Girard street holder.
1882. Commercial Point holder.
1882-1886. Commercial Point works.
1885. Naphtha and crude oil processes.

was advanced to $3.25, and remained at this rate until 1870, when reductions were again begun, and continued until the price has now fallen to 80 cents per 1,000.

The first office of the Company was on Washington street, and it was not until 1855 that the offices were moved into the building on West street, which the Company still occupies. At about the same time (1853) the Company leased land on Washington and Mason streets, where the Boston Theater now stands, and the construction of a small gasholder was begun. But Tremont street was then an important residential district, and protests were so vigorous and numerous that the holder work was discontinued, and the land released. The Company's business was then growing so fast that they desired to extend the North End works, and against this proposed extension most serious objection was urged, and it was alleged that adjoining estates would be caused grievous damage. But as the examination of the assessors' books showed that 220 neighboring estates had increased in valuation 180 per cent. from 1835 to 1857, the Company was allowed to extend its plant.



Meeting Society of Gas Lighting—New York City.

During all these years the North End works were being continually enlarged and improved, and they had a daily capacity for 4,000,000 cubic feet of coal gas when the Commercial Point works were placed in use. The repeated additions to the holder capacity denote the increasing output of gas, and forecast the reductions in price.

Gas was first sold for $5 per 1,000 cubic feet, and the price was gradually reduced to $2.25, in 1860. Fifty years ago the price was $2.50. Toward the close of the Civil War the price

Previous to 1852 the Boston Gas Company was practically a family concern, under the management of Mr. George Darracott, and affairs were somnolent. From 1849 to 1861 the President of the Company was Hon. Samuel A. Eliot. He had been Mayor of Boston and Member of Congress, was Treasurer of Harvard College and was the father of Mr. Charles W. Eliot, the President Emeritus of Harvard University. Samuel A. Eliot was succeeded as President of the Company by Mr. John A. Lowell, 1862 to 1877, whose grandson, Mr. A. L. Lowell, is now President of

Harvard University. Associated as directors of the Company, with M. M. Eliot and Lowell, were Messrs. George W. Lyman, Charles P. Curtis, Augustus Lowell and other equally distinguished men, so that the old Boston Gas Company quite naturally became one of Boston's household "Lares et Penates," along with Plymouth Rock and the Mayflower.

In 1853 the Company was awakened from its protracted lethargy when Mr. W. W. Greenough was made Treasurer and Agent, or General Manager; he held these offices 36 years, or until March, 1889. One of the first steps of the Greenough management was the sale, in 1854, of the Roxbury mains and rights to the Roxbury Gas Light Company; this act of partition was reversed by the consolidation 50 years later. When Mr. Greenough took charge in 1853 he brought with him as complaint clerk Mr. Charles H. Johnson, who is still the cashier of the Company, having a record of 56 years of continuous service! On one occasion a new director asked Mr. Johnson how long he had been with the Company. "Twelve years," was the reply. "Well," said the questioner, "You got a good berth when you came with the Company." "Yes," said Mr. Johnson, "and the Company got a good man."

inspection of gas and meters; the minimum illuminating power was then established at 12 candles, and the gas was required to be *sufficiently purified* from sulphuretted hydrogen, ammonia and carbonic acid. Later the standard of candle power was raised to 16, and quantitative restrictions were placed on sulphur and on ammonia. Still later a quantitative limitation on carbon monoxide was used to prolong a finally ineffectual fight by the Boston Company against the introduction of water gas.

In 1884, the Bay State Gas Company, incorporated by Mr. J. Edward Addicks, of Delaware, entered the field, and his first moves were met by the establishment (in 1885) of the Board of Gas Commissioners. In favor of the creation of such board, one of the reasons urged by the Boston Company was the somewhat uncertain policy pursued by the Board of Aldermen of Boston, as instanced:

In 1854—They voted to give the right to dig up streets to a competing company.
In 1860—They rescinded the order.
In 1866—They voted not to grant petition of a competing gas company to lay gas pipes in the streets.
In 1874—They voted ten to one not to grant permission to another competing company to do the same.
In 1877—They voted unanimously not to grant such permission to another company.
In 1884—Sept. 8, they voted, eight to four, not to give permission to the Consumers' Gas Company.
In 1884—Sept. 26, they voted unanimously to petition the Legislature to appoint a gas commission.
In 1884—Nov. 17, they voted, eight to four, to grant permission to the Consumers' Gas Company.
In 1884—December, they were unable to pass the order over Mayor Martin's veto.
In 1884—December, they unanimously referred to next year the petition of the Bay State Gas Company to be allowed to dig up the streets.
In 1885—Feb. 9, they voted, seven to five, to give such permission to Bay State Gas Company.

American Association at North End Works, October, 1881.

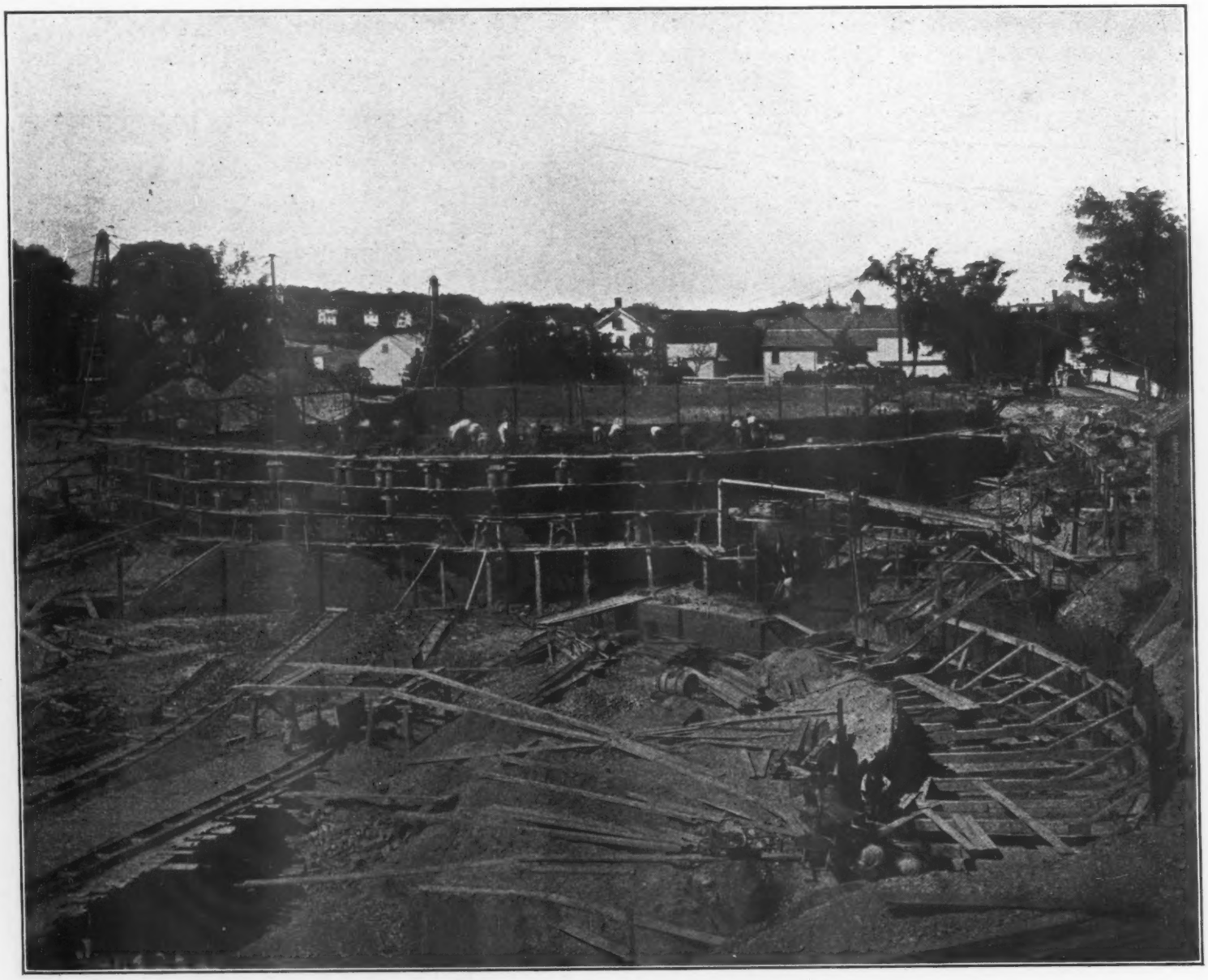
Under the Greenough management, the business of the Company rapidly increased. The piping and fixture business of the Company was sold to the former foreman of the fitting department, and a number of the old fitters began business on their own account. The resulting competition led them to seek customers not only in every new building erected, but also among the business firms, and in old private dwellings, among people who had never before been asked even to think of using gas. In 30 years the number of consumers had grown from 3,000 to 30,000, and the rich Boston gas field began to attract attention of alien capitalists. Not only the Boston Gas Company, but also the South Boston, Roxbury, Dorchester, and other suburban companies, were very prosperous, and the Metropolitan District had become a prize of which the control was eagerly sought by enterprising invaders.

In 1861, the State of Massachusetts provided by law for the

These votes show the gradual overthrow of the influence of the old Boston Company in the Board of Aldermen by the strenuous partisans of the new Bay State Gas Company; and the Boston Company strove diligently for the creation of the Gas Commission as a bulwark for defense against further hostilities of the Bay State Gas Company.

Mr. J. Edward Addicks, the President of the Bay State Company, had acquired control of a process for water gas manufacture, and with this process he was able to promise a higher candle power gas at a lower price than the $1.80 the Boston Company was then charging. At the North End works the manufacture required the employment of an army of men; 400 men made 4,000,000 cubic feet of gas per diem; Mr. Addicks proposed to make 4,000,000 cubic feet with 40 men; but this was water gas, of which the chemical composition was sufficiently different to permit restrictive legislation to be made effective if directed against certain components of the gas. So, some years earlier, a State law had been passed limiting the carbon monoxide to 10 per cent., with the result that unmixed carburetted water gas could not be distributed and sold. The Boston Company had installed the Equitable process, under which an oil-water gas could be made and used to enrich the coal gas at the North End works, but they had opponed the trial of the new water gas process then rapidly developing a new era in the industry. The Boston Company had now built an excellent coal gas plant at Commercial Point, in Dorchester, which represented the best possible construction at the time; this plant, under Mr. C. D. Lamson, and the North End works, under Mr. W. A. Wood, were operating to great advantage. Mr. M. S. Greenough, the son of W. W. Greenough, was the Engineer of the company; he had continuously and successfully supervised the construction and operation of the manufacture and distribution, and he stood in the front rank of gas engineers and managers, serving as President of the American Gas Light Association in 1886 to 1887; at this period (1884-1886) he was President of the New England Association of Gas Engineers. But Mr. Greenough always opposed the introduction and use of water gas. The Boston Company were in excellent condition to withstand attack; electric lighting had not yet begun effective competition with gas; the works and mains were ample and in admirable condition; the price of gas was high, and sales were increasing rapidly. In 1887 the entire capitalization, including capital stock and bonds, of all the gas companies in Massachusetts, was $11,944,522, and the assessed valuation was $12,626,208, and any competing company must face a very substantial opponent.

Soon after the Bay State Gas Company had been authorized by the Mayor and Aldermen to lay pipes in all of the streets of Boston, for the purpose of competing with the other companies, the Bay State Company built its Calf Pasture works in Dorchester, and laid a line of large mains leading into the heart of the city. Critics of Mr. Addicks must concede that he selected a superior site, and that the Calf Pasture works were, and still are, excellent in design, and of the very first class in arrangement and construction. Much of the credit for the admirable character of the plant is due to the Engineers of the Bay State Company, Messrs. Joseph Flannery and Walter R. Addicks—Mr. Walter R. Addicks later succeeded Mr. Greenough as Engineer of the Boston Company.



Tank for Commercial Point Holder, 1882.

Competition did not, however, result from the building of the Bay State plant. The owners of the Bay State Company purchased almost all of the stock of the Boston, Roxbury and South Boston companies, and later secured control of the Dorchester Company. The stocks that the various companies thus acquired, excepting the Dorchester Company, were then turned over to the Bay State Gas Company of New Jersey, a holding or financial company, to be used as collateral for large issues of bonds, the

sales of which gave to the promoters of the scheme substantial profits, and the equity in the stocks then passed to the Bay State Gas Company, of Delaware.

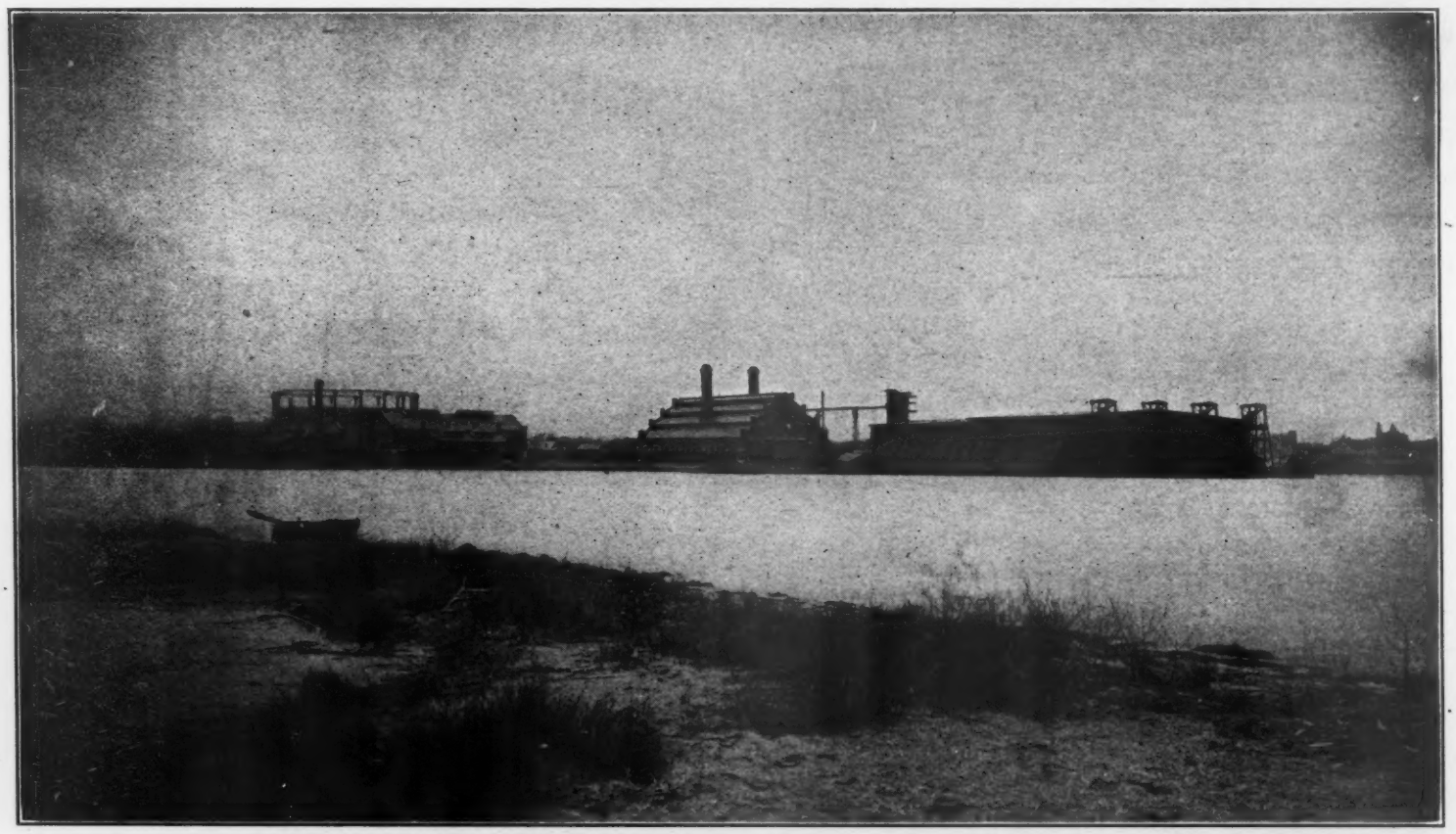
By this method of manipulation a common control was established over the companies by which they could, for certain purposes, be operated as one concern. They maintain, however, their distinct corporate entity, preserving their various prices for gas, although with slight reductions. The public discontent incident to such management, and to the alleged public and private irregularities which attended it, found frequent expression in the Legislature and elsewhere, but without producing any remedial legislation.

The Bay State gas works began to manufacture water gas in December, 1887, and to sell to the Roxbury company, by whom the water gas was mixed with coal gas so that the legal limit of carbon monoxide would not be exceeded. In 1888 the manufacture and sale of water gas were legally authorized, under provisions of license by the Board of Gas Commissioners; in 1889, this board fully investigated the use of water gas; and, in 1890, the last legal obstacle against the sale of water gas was removed by the repeal, by the Legislature, of the limit on carbon monoxide in gas. Meantime, March, 1889, the old Boston Gas Company had passed under the control of Mr. Addicks, who was then its President. The Dorchester works were shut down in 1889, the Roxbury in 1890, and the South Boston in 1894; and the Bay State works supplied gas to these companies and to the Boston company.

Meanwhile, the Boston company had raised the price of gas to some of its largest and most influential consumers, and agitation for lower prices commenced. In 1891 the Board of Gas Commissioners dismissed a petition for dollar gas in Boston. Then Mayor Mathews entered the lists; the commission investigated the operation of the Boston and Bay State Companies, and the operation of the famous note or bond of the Bay State Company of Massachusetts to the Bay State Company of Delaware, for $4,500,000. In June, 1893, the Legislature required the Bay State Company to legally cancel and discharge the note for $4,500,000, and to deliver the cancelled obligation to the Commissioner of Corporations, under penalty of revocation and forfeiture of its charter. The note was cancelled November 24, 1893, and, pursuant with the decree of the Supreme Judicial Court, the company issued in its place capital stock of the par value of $1,500,000, making in all $2,000,000 as representing the market value of the Bay State Gas Company. On May 1, 1893, dollar gas was given to Boston.

But meanwhile the Brookline Gas Light Company, which had previously restricted its business to the towns of Brookline and Brighton, received (in 1893) permission from Mayor Matthews and the Superintendent of Streets, afterward confirmed by the Board of Aldermen, and entered into a contract with the City of Boston to lay mains throughout the city. The Boston Company unsuccessfully strove to have the permits for pipe locations revoked. The Brookline Company also invaded the Dorchester and South Boston districts, and put out $127,000 worth of gas stoves free to consumers who agreed to use Brookline gas one year. Competition was earnest until 1896, when the Boston-Brookline contract was executed, under which the Boston Company agreed to buy from the Brookline Company gas enough to enable the latter company to pay interest and dividends; this contract closed three years of competition, and emphasized the futility of such competition permanently to accomplish the purpose desired.

In 1892, the Boston Company had built, at its North End works, a large water gas plant of the Wilkinson type of apparatus; in 1893 the Brookline Company had built a similar water gas plant with a daily capacity of 4,000,000 cubic feet, at its Allston station; the Brookline Company had laid hundreds of miles of mains, and had gained many thousands of consumers. In 1896, after a stubborn contest, the Massachusetts Pipe Line Gas Company was chartered with powers for making and selling gas. It also had large powers looking to the consolidation of other companies. It was intended as a competing company, and the act fixed low maximum prices for gas. This provision, however, proved ineffective, as the company never sold gas to private consumers. It simply built a large holder and large works for purification and measurement of gas at Everett, and laid its mains to connect with the other companies.



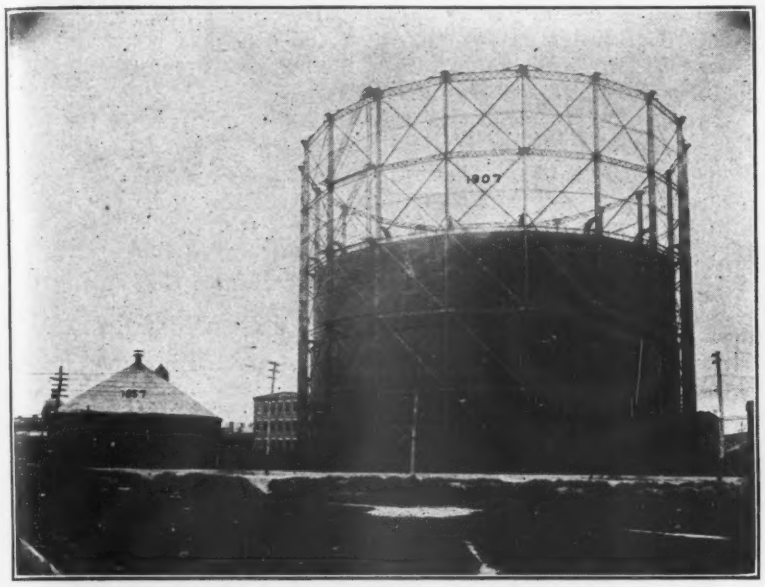
Commercial Point Works, 1882.

In 1897 the New England Gas and Coke Company was organized as an incorporated, voluntary association or trust, and built a by-product plant of 400 Otto-Hoffman coke ovens in Everett, for the manufacture of coke and gas; this plant adjoined the works of the Massachusetts Pipe Line Company. The coke company also acquired all the stocks of the Massachusetts Pipe Line Company, the Brookline, Dorchester and Jamaica Plain companies.

As a result of these operations the several companies supplying gas to the City of Boston (excepting the Charlestown and East Boston districts) were combined for many purposes into two separate groups. The companies of each group, however, preserved their separate corporate existence, rights and privileges. The two groups of companies became sufficiently friendly so that, after the completion of the works of the New England Gas and Coke Company and of the Massachusetts Pipe Line Gas Company, the Coke Company sold its gas to the Pipe Line Company and the Pipe

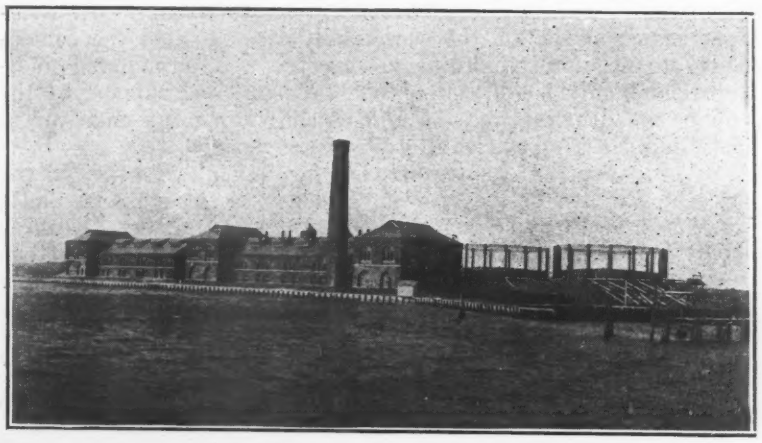
Line Company sold the gas directly or indirectly to all the other companies. Public dissatisfaction and suspicion of extravagant profits continued, and resulted in frequent appeals to the Legislature for redress.

In 1898 the Legislature requested the Gas Commissioners to consider and report to them a plan for the consolidation of the corporations supplying gas in Boston. The board submitted a plan for



The Old and the New.

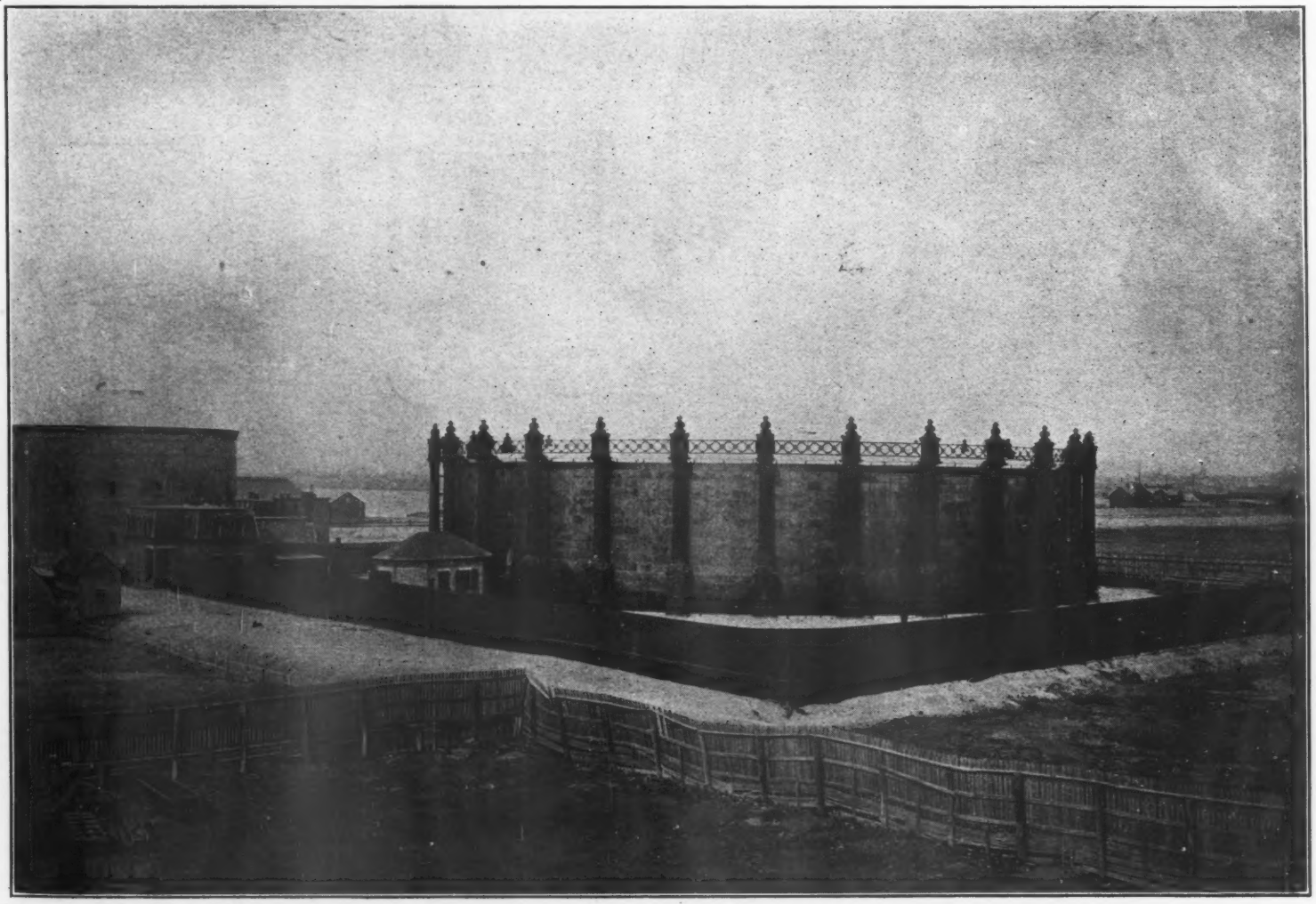
State Company; the Boston Company was buying gas from the Pipe Line Company; the Dorchester Company was buying from the Pipe Line, the Brookline and the Bay State; the Jamaica Plain Company was buying from the Brookline and the Pipe Line, the Brookline and Bay State Companies were buying from the Pipe Line; Dorchester was selling gas to the Roxbury Company; the Boston and Bay State Companies were selling to the Brookline



Bay State Gas Works, 1887.

Company. This mutual trading created a maze that only an expert could unravel.

In 1902 the Massachusetts Gas Company, a voluntary association, was formed to take over the interests of the New England Gas and Coke Company; and, in 1903, this new trust also acquired



Girard Street Holder, 1875.

consolidation in 1899, but it was opposed by the companies, and no action followed.

In 1900 the Legislature investigated the expediency of reducing the price of gas in Boston, and examined into the general conditions of the gas supply. By this time the ownership and control of the different companies were so entangled that another Alexander was needed to cut this new Gordian knot. 1901 the South Boston and Roxbury Companies were buying gas from the Bay

all the interests of the Bay State, Boston, Roxbury and South Boston Companies.

Thereupon, in June, 1903, an act was passed authorizing the consolidation of the eight companies. Before the consolidation was effected, renewed public dissatisfaction developed, and in 1904, a fresh effort was made to secure a reduction in the price of gas, and to restrict the capital stock of the proposed consolidated company. The contest was carried into the Legislature of 1905, and

finally, on June 15, 1905, the Boston Consolidated Gas Company became an accomplished fact, $24,015,622 were paid for the constituent properties, the old companies passed out of existence, and the new Boston Company began its remarkable career under its present President, James L. Richards.

Mr. Richards was elected President of the old Boston Companies in June, 1902, and one of the first tasks he encountered was the continuance of the gas supply during the anthracite coal strike. The successive steps to consolidation were made under Mr. Richards' management, and he successfully amalgamated the component organizations, co-ordinated the processes, stimulated individual and united effort, won the confidence and support of the public, and demonstrated the highest ability in every endeavor to make and direct an efficient public service.

In 1905 the Legislature provided for the investigation of the price of gas, and of the rate of dividends to stockholders, under what is known as the London sliding scale. On May 31, 1906, the Boston Consolidated Company accepted the provisions of the Massachusetts Sliding Scale Act, under which the standard price for gas was made 90 cents, and the standard rate of dividends seven per cent. If, during any fiscal year, the maximum net price per 1,000 feet charged by the company has been less than the standard price, the company may, during the following year, declare and pay dividends exceeding the standard rate in the ratio of 1/5 of one per cent. for every one cent of reduction of the maximum net price below the standard price. The standard price is subject to revision at the end of 10 years.

The price of gas had been reduced to 95 cents, July 1, 1905, to 90 cents January 1, 1906; it was still further reduced to 85 cents July 1, 1906, and to 80 cents on July 1, 1907. When we recall that, in 1888, the cost of gas in the holder for the 20 largest companies in Massachusetts varied from 63 to 86 cents per 1,000, we find that today gas is sold to consumers at prices lower than the holder costs of 20 years ago.

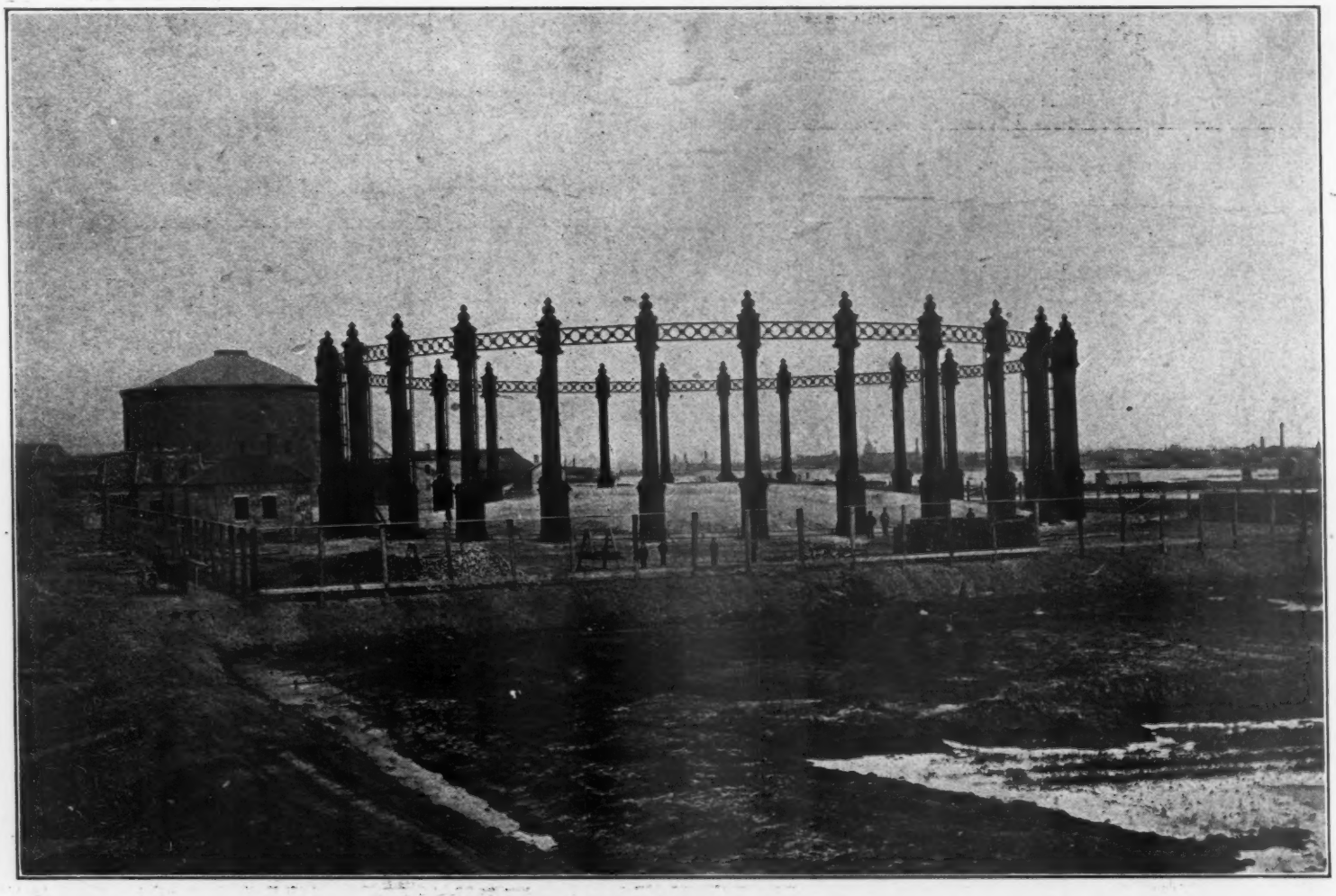
The consolidation had been effected, the sliding scale protected the interests of the consumers and of the stockholders, and Mr. Richards next turned his attention to promoting the interests of the employees.

In 1906 he established the profit-sharing plan, under which employees receive on their annual salaries or earnings a dividend of like per cent. as the dividend declared to stockholders. Every employee, except the President of the company, is eligible to designation as a profit sharer. In this way, the interests of the employees have been identified with the interests of the company; and it is probable that no other great corporation has more complete co-operation on the part of its people, nor more earnest, zealous work for the employing company.

As soon as the companies were consolidated, many extensions and improvements to plant and mains were begun. In 1908 a new plant at Everett, of 14 million daily capacity, began the manufacture of water gas to mix with the oven gas bought of the Coke Company, and the growth of the business promises to exceed the present capacity of this new plant.

Any history of Boston Gas must include a reference to the New England Association of Gas Engineers, and to the Guild of Gas Managers. Both these societies have held their meetings in Boston for many years, and the Boston Company has always actively served with them in many ways. The American Gas Light Association held its annual meetings in Boston in 1881 and in 1901.

Among the many important events of Boston Gas during the past 50 years two are of particular interest. During the great Boston fire, in 1872, a number of gas explosions occurred without damage to persons, and the supply was shut off from the city on November 18; after the fire the mains were valved, and now any section of the streets can be isolated. Gas was again shut off the city during the great fire Thanksgiving Day, 1889.



Girard Street Holder, 1875.

The photograph of the Central Station Holders, 1857 and 1907, shows in a striking manner the progress of 50 years; the 1857 holder has 80,000 capacity; the 1907 holder has 4,000,000 capacity. In 1859 there were 10,317 consumers, in 1909 there are 120,000 consumers. In 1859 250 million feet sold at $2.50; in 1909 the price is 80 cents and the output is 5,000 millions. In 1858, December, 70 per cent. of the daily output was burned between 4 P. M. and 11 P. M.; in December, 1908, 50 per cent. was so burned. In 1859 there were 67 miles of mains; in 1909 there are 870 miles of mains. In 1862 there were 376 water valves in use; in 1909 there are 8,900 slide valves on mains.

In 1859 nearly all the coal used was Pictou, costing $6.75 per chaldron, and coke sold for $3 per chaldron. In 1864 coal cost $14 per chaldron; coke brought $9.50 per chaldron. In 1884, 25 years later, nearly all the coal used was American, and the average cost was $5.43 per ton. In 1859 the make per pound of coal was

3.80 cubic feet; in 1887 the make per ton of coal was 11,435 cubic feet.

In 1856 whiskey and rum consumed at the works cost $3,455.38; in 1909 the use of liquor in the works is prohibited; indeed, after 1869, no supplies of whiskey were purchased for the laborers. The enormous consumption of liquor denoted by the item of 1856 represents nearly 1½ cents on every 1,000 cubic feet sold. Nowadays the cause of temperance is helped by the requirements of public and corporate service that responsible employees shall be sober and abstinent, and there is a constant elevation in *morale* which we usually do not appreciate or observe unless it is disclosed by a review of the progress of 50 years.

Just a closing word on municipal ownership: In 1891 the Legislature authorized the establishment of municipal plants. January 5, 1905, Boston voted favorable to acceptance of the act; since then the successful administration of the company under the sliding scale has been so satisfactory that no further interest has been shown in a municipal gas plant, and in the whole State of Massachusetts there are only four municipalities controlling their own gas supply. A just return from good service has satisfied both the companies and the consumers.

With the passing of the half century, it is timely to note the careers of some of those engineers who have left their impress on the work of the Boston Gas Company. Mr. M. S. Greenough went from Boston to the presidency of the Cleveland (Ohio) Company. Before the contest between competing companies distracted the Boston public, Mr. C. D. Lamson became Manager and President of the Worcester Company, where his conduct of affairs elicited the approval of the public and the admiration of his colleagues. Mr. W. A. Wood, who came to Boston in June, 1884, is now the Vice-President and Chief Engineer of the Boston Company; his associates marked the completion of his 25 years of service, a few weeks ago, by presenting him with a silver cup, and it is said that this is the first and only time that the chief has ever been handicapped for words; nothing else has ever taken him by surprise. Mr. Walter R. Addicks achieved a signal success in sailing the Boston craft through dark times and stormy periods; and went from Boston to the New York Consolidated Company, as its First Vice-President; his skill as a pilot was soon requisitioned in his new position. Mr. E. C. Jones, who succeeded Mr. Wood at the North End works, later went to San Francisco, and his name is a household word on the California coast.

So the Boston Gas Company has spread its influence beyond the borders of the home city; like the gilded dome of the State House, may the policy and performance of its gas supply remain a safe beacon to guide gas mariners in distress, and to cheer travelers with the certainty of a hospitable anchorage and a friendly welcome.

Development in Pipe Manufacture.

[Prepared by Mr. George W. Whyte, Philadelphia, Pa.]

If a leading manufacturer of cast iron pipe were asked what advance has been made in the trade in the last fifty years, he would answer probably, "Well, broadly speaking, there has been little." Curiously enough, this is nearer truth than cursory inquiry would indicate, and argues well for the merit of the original conception, or poorly for its subsequent sponsors, depending upon the point of view. Adequate record of the advance in that period would be really a treatise on the minutiæ of cast iron pipe making with here and there a phrase of larger dimension, yet the whole missing the scope and purpose of this issue.

Evolution in the processes and product of any manufacture is largely slow accretion of individual experience in the development of detail and gathered from widely different sources. To trace it accurately to point of time and individuality is difficult, often impossible. Almost without our realizing it, the accumulation is welded into best or standard practice largely by the running discussion of technical journal and engineering society. In this current devotion to detail the value of perspective is lost in casting up the progress of an art. It may not lessen interest, therefore, to range briefly on the historical phase.

While the joint demands of water and gas have developed the modern system, water piping led the way. The accompanying illustration suffices to indicate the change in material and form from ancestral times.

In this day of concern over the conservation of our natural resources, it must be satisfying to realize that a 20-inch main for 400-foot head need not be laid in a 5½-inch thick lead pipe, nor in one of 2 inches in copper.

There is also cheer under similar reflection on observing the material and process of manufacture of the immediate and persistent forerunner of our present cast iron distributing systems. Like the latter, its era was marked by improvement in method of manufacture for ease and accuracy of production.

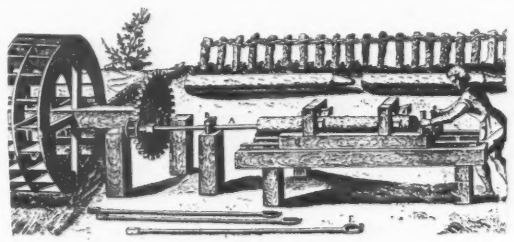
Early Forms of Lead Conduits.

Those responsible for maintenance of lines will also appreciate the relegation to a historical period of the following joint from Jamaica Pond laid about 1796.

Boring Logs for Pipe.

Nor will this sense of satisfaction be lessened on noting by what a narrow margin our present "Captains of Industry" have escaped some of the tribulations of their predecessors.

It is well for us, too, that the passing of the old carried with



Improved Method of Boring.

it the doubt of the inability of cast iron conduits to withstand the shock of traffic.

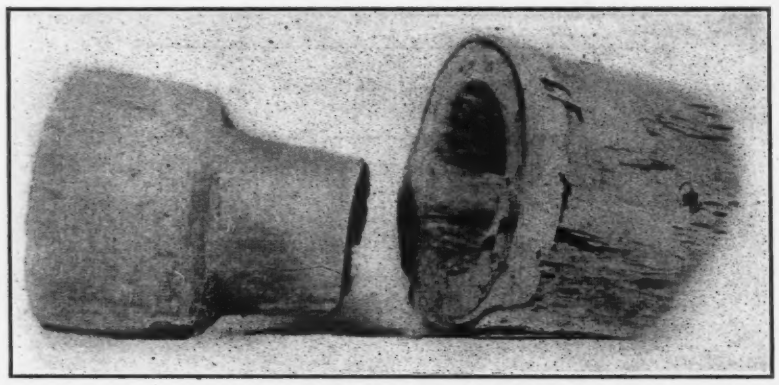
While the first mention of cast iron pipe we have found referred to the middle of the 17th century, all transitional periods have their overlap; our grandfathers largely used wooden pipe and this generation has seen its general replacement by cast iron. Though London had cast iron pipe in 1746, it did not generally supersede its wooden mains until about 75 years later. Winsor's and Murdoch's first gas mains, near the opening of the 18th century, were respectively of lead with soldered edges and of tinned iron pipe, while to a much later date, if not even now, riveted tin plate with asphalt coating was used in Europe. Still, near the same period, even flexible joint pipe, 15-inch and later 36-inch, was laid under the Clyde, and turned spigots fitting in bored bells were introduced in 1826.

In our own country, iron pipe founding was much stimulated

in the early part of the last century by the increasing and insistent demand of the larger municipalities, for adequate and reliable distributing systems. Much of this incentive centered about Boston and Philadelphia, though the use was gradually expanding and Detroit had some 3-inches in 1830.

The memory and tradition of present old foundry warriors (not a misnomer) focuses around the period from 1825 to 1860. It includes "The Boston Contract", about 1846, and which every veteran seems to remember though not always quite certain of the date. Besides, that city had superseded wood in a 10-inch main and contracted for its new water works, while Philadelphia installed a 16-inch pumping main for its wooden distributing system.

The present magnitude of similar work in gas and water piping makes these first efforts seem trivial, but they show that not much more than fifty years ago the American pipe industry was in an important phase of its progress.



Bell Spigot Ends from Wooden Pipe.

Weymouth, Millville, Florence and Camden, all of New Jersey, and Conshohocken, Pa., were largely identified with the early struggles and development of this manufacture. It was in Millville that R. D. Wood succeeded his brother David in pipe founding, and by interests acquired in Florence and Camden, made the present well-known Philadelphia firm of R. D. Wood & Co. the largest manufacturers in this product.

The early design of pipe was characterized by directness of line and consequent angularity. The bell was made straight, an

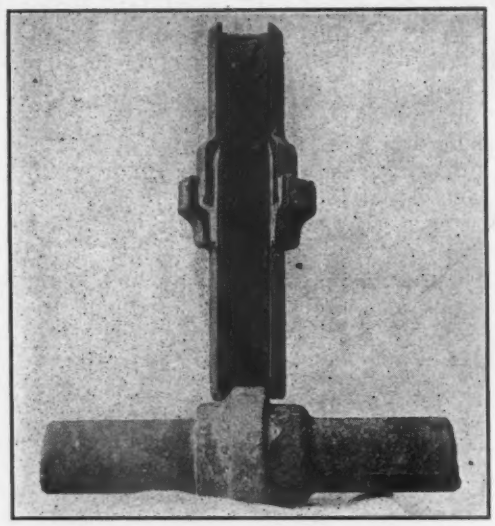
Section of Wooden Pipe (Removed 1884).

abrupt expansion of the pipe barrel, and there was no bead on the extreme spigot end. Instead, a body flange was cast on a few inches back and this, in laying, abutted against the bell and limited the length entering the socket.

In the first days of gas lighting, bolted flange pipes with card board gaskets were used, but from breakages were soon superseded by the lead joint. The oval, triangular, square and polygonal flange gave place to the circular. The separately cast and bolt attached outlet connection, manhole, etc., were replaced by "Specials". These, in turn, lost the abruptly angular intersection of the branch with the main and acquired the radial curve and flow of outline of the modern product. The compound joint of our illustration, laid in Burlington, Vt., also claimed attention and, incidentally, it shows incrustation.

While the 6-foot and 9-foot lengths are still used in the small sizes, the 6-foot for 3-inch and the 9-foot for intermediate sizes to 12-inch have been replaced by the standard 12-foot laying length.

There are still differences in detail of design in spigot, bell and diametric dimension for a nominal size of pipe. However, one of the gains in recent years has been a well-directed co-operative effort of manufacturers and engineers to standardize the product. Indeed, standardization in several lines is taking on international scope, a consummation worthy of all encouragement.



Compound Joint.

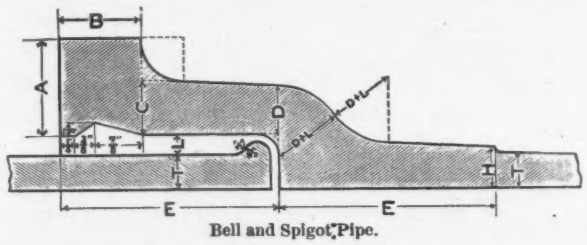
Formerly, for the outside diameter of a given internal size of pipe, there were likely to be as many sizes of body pattern as there were engineers desiring it. The fixture yard of most foundries thus contains many durable monuments suitably epitaphic of particular contracts, while pattern lofts for specials would form good ground for study in differentiation.

One effort now is to secure four standard classes of pipe, A, B, C and D. For each size of pipe from 4-inch to 24-inch inclusive, there are proposed two standards of outside diameter; for pipes from 30-inch to 60-inch inclusive, four standards for each. All pipes of a given outside diameter are to have the same interior dimension at each end. Then, for any desired variation in thickness and weight, the inside diameter will gradually increase for about 6 inches at each end of the pipe until the required standard of thickness and weight is obtained for each size and class of pipe. Thus the burden of any variation is borne by the easily variable core and not by fixtures of greater cost and of more permanent character and dimension.

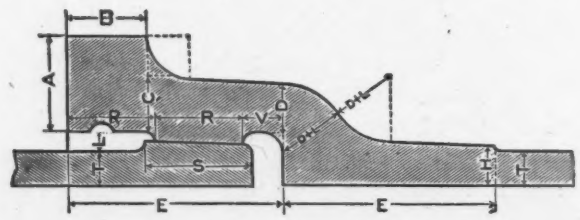
The specials it is proposed to standardize similarly, reducing the number of patterns required and possibly adapting these so that one standard may serve two classes of pipe.

These suggestions are for one field of usefulness and are probably largely tentative. We cite them simply to show the trend of thought among a large class of experienced engineers and makers.

The attention given to the development of detail to which we initially referred, is well exemplified in the accompanying illustrations. These show the direction of effort in standardizing con-

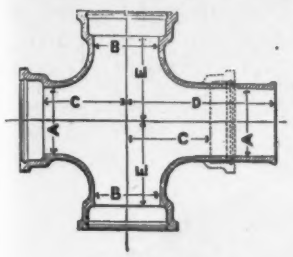


Bell and Spigot Pipe.



Turned and Bored Joint.

tour and dimension. Each letter refers to tabular standard for a given size of pipe and such general uniformity of product would seem desirable.

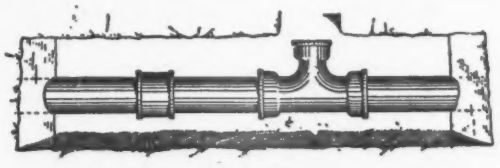


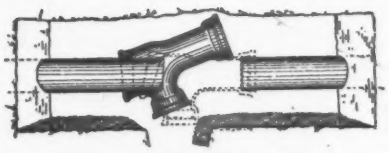
Standard Cross.

Economy in production of cast iron pipe is not dependent upon unique foundry methods, but on the great number of essentially similar pieces turned out. This permits labor to be highly specialized; gives opportunity for establishing of a fixed routine or sequence of operation, and a familiarity with the niceties of skillful manipulation which the volume and speed of low cost production require. The cost of foundry fixtures and rigging is large. Any improvement which extends their period of utility and range of usefulness must be reflected in price and quality of product.

While on this question of design, we may mention the "cutting-in" special which has come into use in more recent years.

Its purpose is to reduce the labor and expense of inserting a branch connection in a line already laid. It has an enlargement back of the bell, the face of which is made slightly oblique. As the illustrations show, there is less excavation, fewer joints, no need of blocking pieces, and the variation of an inch or two in the section cut out occasions no trouble or delay. This design of bell with a spigot or regular bell on a short length of pipe, can be used for a change of grade or alignment less than a curve would require.


The Old Way.


The New Way.

Reduced "Special."

The "reduced" special is another departure in design to secure compactness. It is made as short as possible and with bells all around. It also meets a demand for a special which may be sold at a fixed price instead of per pound.

Probably in no department has cast iron pipe making advanced more than in the selection and control of its raw materials; pig iron, coke, blacking, etc. A well equipped chemical laboratory with facilities for physical tests is a feature of control appreciatively used by the progressive and modern foundry. Not only does it avoid initial errors in the purchase of supplies, but it also aids greatly in locating causes of disturbance to normal conditions. Sometimes this is not done by direct proof, so to speak, but by its elimination of plausible explanations for irregularities. Previous practice was obliged to accept many of these as among the number from which the management might choose. It is often a great aid to expeditious correction to know to what our trouble is *not* due and thus restrict the range of investigation. Many a dirty, spongy or blowhole-afflicted pipe has rolled its dismal way to the scrap heap, followed by emphatic protests against dirty iron or bad coke, and which mediums had not the remotest connection with their disordered state.

Now, supplies are often bought on specification of chemical composition and physical characteristics. Coke must show to the experienced chemist its content of sulphur, ash, fixed carbon and moisture and bear the proper proportion in a sound body. In the purchase of pigiron, its grade and range of composition are specified and on its receipt is analyzed for its silicon, sulphur, phosphorus, manganese and its carbons. The known influence of these elements on each other, of their resultant action in a mixture, and on soundness, shrinkage, strength, chill, fluidity and hardness, are now factors in selection and mixture of irons quite unfamiliar to the trade not many years ago.

By judicious purchases in variety of stock and intelligent discrimination in their mixture, a large control is given over the production of castings of desired physical character.

Daily analyses are made of the pipe and irregularities due to stock iron or fuel are promptly corrected and generally forestalled. Severe losses persistently attributed to bad iron or coke, have been shown due to negligent or careless shop work. Such losses, in former times, often have been accepted as among those unfortunate, unavoidable contingencies of the business.

Of course, a much wider range of irons, etc., is available than ever before, and it is not as difficult to secure suitable supplies. The grades and composition of irons should be what might be termed complementary, so that the pipe iron will be the strong, tough and even grain of the specification, yet soft enough to drill, cut or machine.

By increasing skill in the blending of different brands and a supplementary careful supervision of cupola operations, charging, etc., large insurance is gained against a character of loss once too prevalent. It also escapes the burden of creating undue demand for some particular furnace make, or brand, which sometimes brought uncertainty of delivery and increased price.

In the infancy of the American industry, pipe were moulded from split wooden patterns having the complete form of the pipe, with bell and spigot; even the cores had wooden spindles They were fashioned much after the manner of present green sand moulding, in green sand, in wooden flasks, in about 9-foot lengths, and were cast on their sides. Wooden core spindles were in use as late as 1840 and the cores were dried over a charcoal fire built on the floor. The ends of the cores were supported on a runway on which they were rolled back and forth by hand until dry.

The first pipes cast in Weymouth and Millville, around 1830, were moulded on their sides on the pig-bed of a furnace smelting bog iron ore. They received the molten iron directly from it and any surplus iron was run into the usual pig iron form. The first 16-foot main for Philadelphia was cast in this way.

Later on, 12-foot lengths were cast in green sand on their sides and the smaller sizes to 6-inch and 8-inch as late as 1860. With increasing trade, objection grew to both the method of casting and the use of iron direct from the smelting furnace. This led to the design and erection of plants especially adapted for this manufacture.

A little over fifty years ago, or about 1851, there was a red-letter day in the history of American practice. It was a celebrated, a unique, an epochal event, and a distinction for Conshohocken, Pa., when it made a 30-inch pipe, the largest in the country, the first made in dry sand, first cast vertically and made for Boston.

Since that day, dry sand pipe moulding and vertical casting have become the general practice. It is essentially the same though modified in details of practice and fixtures. The moulds are longer and made a 12-foot laying length of pipe. In the larger sizes these flasks are for single pipes and made in cylindrical sections of varying construction. For the smaller pipes, single pipe flasks in halves vertically, hinged flasks, flasks for two pipes and triple pipe flasks are all in use; skillfully designed in minimum of metal and maximum strength, for they have rough usage.

The short body pattern has succumbed to the long, the iron one has replaced that of wood, and head patterns, now works of art, are made solid rings of metal up to 20 inches, instead of in sections as are the larger sizes. Indeed, to meet increasing demand and rigidity of inspection, it is only in this durable iron form that the necessary nicety of construction, facility, and accuracy of adjustment can be secured in moulding paraphernalia.

Specially designed drying ovens dry the cores mounted in number on all iron frame work carried by a car. The moulds or flasks for 20-inch or less are generally dried in closed ovens; larger sizes are dried thus or on open ovens and, in some, producer gas has replaced the solid fuel.

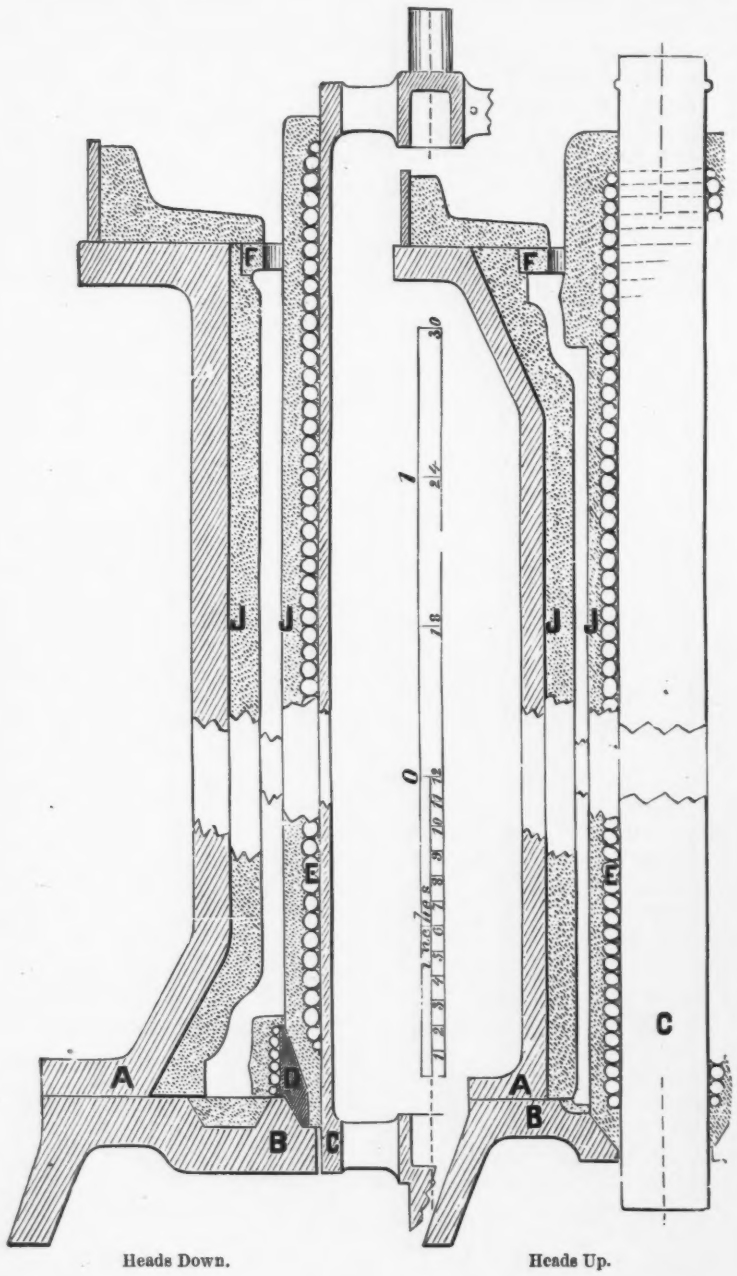
The casting of pipes "heads down" is a general practice, and the rule for larger sizes; smaller sizes sometimes "heads up". Above 16-inch, recent specifications prescribe all must be cast heads down to insure solidity of bell.

Description might go to wearisome length on modifications of detail for facility, accuracy, rapidity and soundness of manufacture and get beyond the intent of this article. Perhaps it will suffice to show the essential features of a completed mould ready for pouring, one for heads down, another for the reverse method. A halve section is shown of each mould.

In these, A is a flask resting upon a seat or chill B and always properly guided by some device of fixture to a definite position. J is the tempered moulding sand rammed around the body-pattern and the head-pattern which encircles its base. The former is withdrawn as soon as ramming is completed, the mould lifted to the blacking stand for its interior coating of this material and

then conveyed to the drying oven. C is a cylindrical, perforated iron shell or "spindle" with ends designed for support in a lathe-like core-making machine in which it revolves. Upon its barrel is wound the machine-twisted hay or straw rope, E, which is then covered as it turns with a coating of tempered clay mixture, J. When receiving its finishing coat, the surplus material is scraped off by a "strike", or metal-edged board, placed lengthwise of the core. This, set at the proper distance from the core center line, and having its edge cut to the desired contour of the core, gives it proper shape and dimension. It is then removed for drying and subsequent blacking.

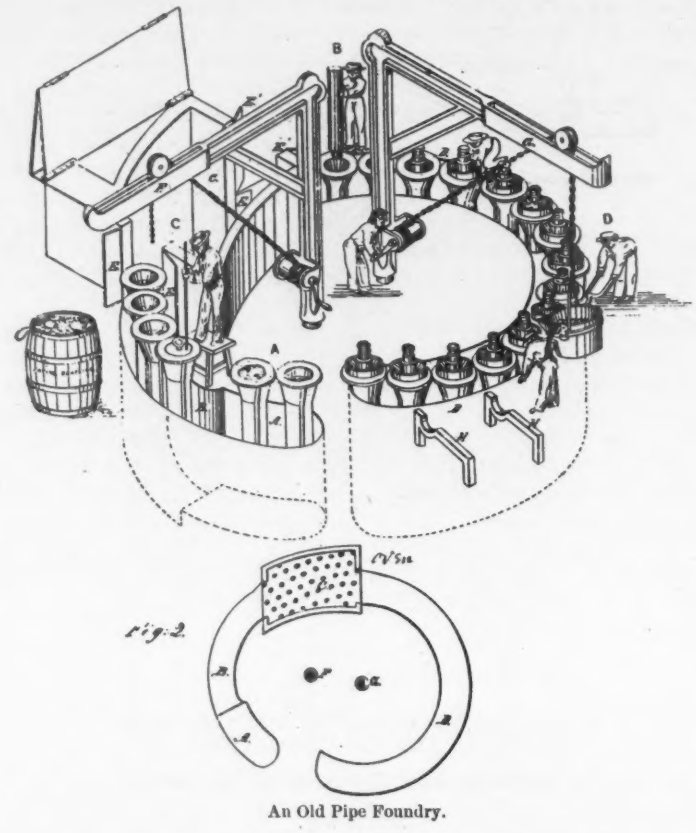
Meanwhile, there is moulded upon the hay-roped socket, D, that portion of the core giving the interior shape of the bell, while the bead or "cake ring", F, is separately moulded also and both removed for drying.



Heads Down. Heads Up.

In "heads up" moulding, essentially the same procedure holds true, except the bead is formed by a metal form or, in some sizes, by a rubber bead ring that, on withdrawing the pattern, is brought away with it by a recess in the pattern. The exterior bell is formed by a head pattern as before, but inverted and adjusted at the top. The interior shape of the bell is turned upon the core, or is formed by a separately molded "slip socket" made to encircle the core and having a flange-like projection replacing the bead or cake ring of the heads-down practice. When all parts are dried they are assembled on the casting seat, as shown in the illustration, and the mould is ready for pouring.

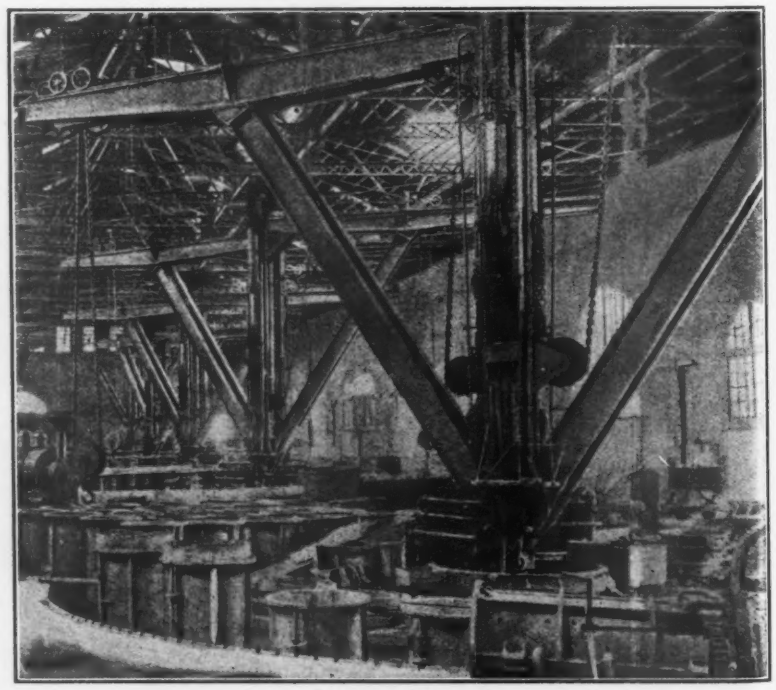
Much of the advance of the last 50 years has been in the introduction of labor-saving machinery an increase of output per unit of labor. This is shown in the accompanying illustrations. The first shows an old foundry where much heavy manual labor was performed and even the mechanical helps provided required supplementing by great physical exertion. The cut shows the process in casting heads up and the plan view of the pit with its drying oven served by the hand-crane. The second cut shows a much more modern foundry in which the striking features are the



An Old Pipe Foundry.

several pipe pits served by heavy cranes with all-mechanical motions for hoist, hand and run-around. Trackage for diminutive locomotives and roomy working areas are features of present-day practice; and, not least, well lighted shops.

Among the labor-saving and speedier operation devices is the core making machine, and that for the twisting and reeling of hay rope, both of which are shown on following page.

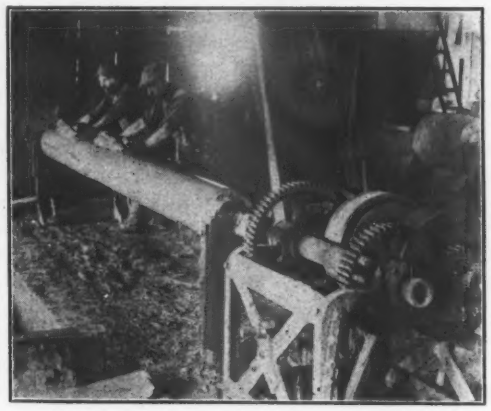


A Much More Modern Shop.

Much attention has been given to ramming devices to replace hand operation, and several are in successful use. Among the devices tried or in service are a series of ramming tools electrically operated, pneumatic, packing, drawing and slicking rammers, some of which might be more happily named and which work with varying degrees of success. Then there are electrical traveling and jib cranes, cupola charging apparatus, electric and otherwise, sand mixing machines, "dolly" tubs for mixing and grinding the stock for cores, and machines for moulding socket cores. The cupola

has kept pace with other features and gives longer and cleaner runs with better metal.

Of course, many things have been tried, some failing promptly, others working fairly or successfully under special conditions, but do not meet the needs of general practice. It may be that we shall yet see a permanent mould, an acceptable collapsable spindle



Core-making Machine.

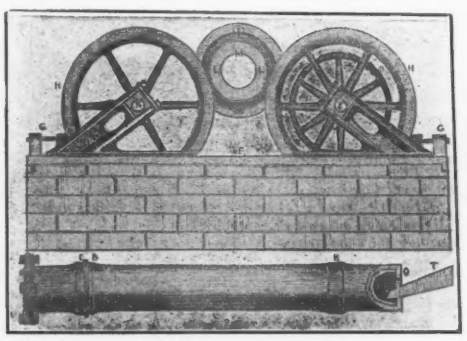
and a cast iron pipe made by centrifugal action in a revolving mould first patented in 1809.

Testing and inspection have grown more rigid. The hydrostatic test is universal with its hammer test while under pressure; 2-inch by 1-inch test bars are required to be broken flatwise upon supports 24 inches apart, and must support at the center a load of

Hay Rope Manufacture.

1,900 lbs. with a deflection of not less than .3-inch before breaking. Tensile bars may be used if preferred, and shall show 19,000 lbs. per square inch.

Diameter of sockets and spigots may not vary from the standard by more than .06 of an inch for 16 inches or less diameter, and intermediate increasing allowanee up to .15 of an inch for a 60-



Centrifugal Pipe Casting.

inch pipe. The thickness of the pipe barrel for thicknesses of less than 1 inch have a leeway of .08-inch below standard and .10-inch for greater thicknesses, though small areas within 8 inches long get an excess allowance of .02-inch and specials 50 per cent. more than straight pipe.

Shrunk bands for beads on cut spigot ends are permitted where they do not exceed 12 per cent. and are not placed on pipe cut to less than 11-inch laying length.

In specification as to weight 5 per cent. is deemed reasonable in 16 inches or less and 4 per cent. for larger. However, total number of pieces multiplied standard weight plus 2 per cent. is the excess limit above total contract weight.

To escape some ills pipe are heir to, sink heads are frequently cast on pipe, especially flange pipe. Such practice insures good ends, and there is a net economy in obtaining these by the frequent saving of otherwise lost labor and machine work.

In general, the inspection of pipe has been the same for some years, although there is more of it. The existence of pipe infirmity or any unkempt appearance is promptly recognized by the average inspector. Pipe may not now be stripped from the mould while "showing color" and must be smooth, round, and true to form and dimension, within narrow limits. Indeed, to one familiar with the process the wonder is that like approach to perfection can be attained from such materials as sand, straw, mud and metal.

In former years many pipe escaped the water and hammer test, and inspection was sometimes omitted; still, it could be severe on occasion.

In this connection, I recall a recently related story of a worthy pipe founder of some 50 or 60 years ago, when ruefully gazing over the results of a spring inspection upon a winter's work. It has seemed to the writer an appropriate illustration would be the often pictured retrospective Napoleonic pose at St. Helena. Thus standing, we can hear this veteran founder saying (expurgated):

"Last fall I had 1,000 tons of pipe and 500 tons of coal; to-day I have 1,000 tons of scrap and all my coal is gone."

Public Utility Commissions.

[An Address Delivered by Mr. RUFUS C. DAWES, on Occasion of the Banquet, Illinois Gas Association, March, 1909.]

Under our Government the utmost individual freedom has stimulated the utmost individual effort and ambition; but, as it is difficult to maintain the balance, in recent years there have occurred many undoubted abuses of this liberty of action, particularly by corporations and other organizations. The unrestrained activity of some of our citizens has appeared, at least, to infringe upon the interests, if not the rights, of the many. The necessity for some readjustment has impressed itself upon the public mind. Many members of that political party, whose watchword in the past was that the "Government that governs least govern best," and many of the opposing parties also, are now favoring an almost indefinite extension of the inquisitorial and regulatory action of Government; and, turning from an inherited love for home rule, as applied to municipal affairs, are now favoring the regulation by the State of certain strictly local relationships. I mention the contrast between old ideals and new ideals only to emphasize the necessity for caution. We may safely leave to publicists and statesmen the discussion as to the safety and advantage of applying such regulation and of transferring such matters to State control. I should not claim that our knowledge of the particular business concerned would lend value to our counsels on proposals involving such intricate and important questions as the maintenance of home rule, the extension of the inquisitorial and regulatory powers of Government, and the expansion of executive authority. We must accept conditions as we find them, conforming our actions to the undoubted desires of the general public. But with the particular application of this general tendency to public utility corporations, we ought to express ourselves, notwithstanding the possibility of its being charged that our expressions are dictated by self-interest.

The specific manner in which these general tendencies of the times affect our interests, is by the formation of commissions in several States, and under consideration in others, to transfer from local control, and commit to the State government, the relations between the cities and the corporations supplying them with gas, water and electricity, and, in some cases, those providing them with transportation. The general object, sought and accomplished by these laws, is to transfer from municipal governments to the administrative department of the State, the control of the Public Utility Corporations, under a general law which confers upon a commission to be appointed by the Governor, ample powers to regulate business relations, and especially conferring the power to regulate prices, and in most cases imposing the duty to limit the issues of capital stock.

I shall speak, therefore, of those powers conferred upon these commissions, to regulate prices and to limit capitalization, and

consider them with reference to the accomplishment of the following object, namely: The maintenance of good service, widely extended, and offered at a low price. I maintain that, in the service of gas, water and electricity, the interests of the public require the delivery of these products to practically every household within the city limits. This, at least, should be the ultimate ambition, and the value of such service is clearly measured by the proportion of its actual customers to its possible customers. This is even more important than price; for what does it profit a man living off the mains to have gas sold to others at the lowest of prices?

Such laws, therefore, as are to be considered should seek to accomplish the extension of the service as well as the reduction of the price. This, indeed, should not be difficult to accomplish, for under ordinary circumstances the extension of the service by enlarging the sales automatically reduces the costs, and (where the power to regulate prices is exercised) will lower the selling price. And upon the other hand, the experience of recent years has convinced most of us that the reduction of selling prices often stimulates business so rapidly as to invite and justify the extension of service. With these objects in mind then, let us consider the fairness and the effect of these general provisions that confer the power to regulate prices, and that impose the duty to limit capitalization to the amount of cash paid in to the company.

Notwithstanding the old view that a franchise is a contract, of which price is an essential element, the conception to-day is that the regulation of prices is justifiable and necessary. The exercise of this right, it is claimed, is justified by reason of the privileges extended to the corporations, and necessary in order to protect the public against the extortion of monopolies, which undoubtedly do require some further restraint in the matter of prices than could be afforded by a franchise or contract extending over a period of 20 years or longer. The courts in most of our States have held that this right to regulate price may be conferred by the legislature upon municipalities, and in transferring this right to the commission, nearly all these general laws already adopted have protected the rights of the companies by requiring the commission, in determining the price, to recognize all the elements of investment, and all the factors of cost, and to allow a fair return upon investment.

It is to be expected that a commission, dealing exclusively with such matters, would consider more carefully and scientifically the matter of investment and the cost of manufacture, than a city council could. There would appear to be a discrimination against public utility companies if the amount of earnings to be allowed upon a specific investment were limited to any fixed rate. The man who builds a business block in a town of 20,000 population, or the man who puts up a building for conducting a drygoods business in a town of 20,000, finds his property much enhanced in value if the town increases to 40 or 50 thousand population. Every man who owns property in the town, and every farmer who owns land near the town, shares also in the advanced values caused by increased population. The fixing of a specific rate of earnings upon capital invested in public utility companies would exclude these properties alone from this enhancement in values, and the justice of depriving such companies alone from sharing in the increased values arising from increasing population, is not clear to me. Perhaps city councils would deny the claim of Public Utility Companies to any shares in this unearned increment, but, except in Massachusetts, I know of no reason why these commissioners should not recognize it.

There are indeed some important advantages incidentally granted to the companies under these commission laws, and among these may be mentioned: First, the exemption from annoyance by franchise grabbers, the laying of the ghost of competition threatened only for the purpose of extortion; second, the reference of all disputes to a semi-judicial body removed from local enmities; and third, the recognition, in some cases by terms and in others by implication, of the perpetual and exclusive nature of franchise rights to existing companies. And this recognition is logical, for where prices are regulated with due regard to money invested, what community would assume, and what commission permit, a duplication of investment?

We could hardly deny that the exercise of this right to regulate prices is fair to the companies, for it appears to be a right already established, and in its application the commission is required to consider the actual sums invested, and to afford a fair return thereon, considering all the elements of cost. It appears, also, to afford an absolute protection to the public. It is not my purpose now to discuss the necessity for providing such protection. It is open to argument; but the consensus of public opinion demands it, and we must admit that the power to regulate rates guarantees this protection, for the establishment of this power will not check, rather will stimulate the voluntary efforts made by the companies to reduce the selling prices. The reduction of prices increases sales and up to a certain point, as yet undetermined, thereby increases net earnings. The increase of net earnings invites the further extension of service. The regulation of prices, therefore, appears to be fair in principle and beneficial in effect, considered with reference to the accomplishment of the objects desired, namely, the reduction of price and the extension of the service. It appears likely to accomplish both these objects.

Upon what grounds, then, is the right asserted and exercised to limit the capitalization of this class of corporations alone, to the amount of cash paid? Is this exercise fair, and will the effect of it be to extend the service and reduce the price? The position I take is that there is nothing to justify it in principle, and that whenever exercised it may be expected to reduce the service and increase the price.

The issue of so called "watered stock" has aroused in public discussion the utmost criticism. The custom has been condemned, and some of the fairest minded of our public men have expressed themselves as favoring laws designed to cure this so-called evil. The assumption is that by the issue of such stock, there is some misrepresentation as to the value securing it, and that the public purchasers of corporation stocks would be in some manner more secure if the amount of stock to be issued were limited to the amount of money paid in. When we consider that perhaps 80 per cent. of the business done in the United States is done through corporations, and that perhaps 80 per cent. of those corporations have, in one way or another, issued watered stock, we may well pause to consider whether a device, which has come into such universal use, may not have its necessary function to perform; but before we enter into the discussion of the larger question, we should inquire into the justice of limiting capitalization of public utility companies as distinguished from all other corporations.

It has been urged with respect to public utility companies already organized, that the commissioners, in regulating selling prices, would feel obliged to recognize the existence of a vested right in earnings already established, and to make their estimates of manufacturing cost, not upon the basis of actual cash invested, but upon the amount of securities issued and established upon a permanent dividend paying basis, and that in such cases, where so large a concession had been made to the holders of such securities, the interests of the public would demand protection against the further conversion of watered stock into fixed investment. As a matter of fact, neither these laws, nor the consensus of public opinion, has determined that this will be the basis, though recent decisions of the court indicate that it may be.

Now, with respect to these companies, taking as a basis the amount fixed by recognizing the vested right in securities already issued, all additions to that amount would come under the control of the commissioners, and every dollar added to that investment would be subject to their scrutiny. Since the additional money actually invested, added to the amount fixed as recognizing vested interests, is to be the basis of fixing rates, what possible objection could there be to permitting the stockholders to write in corporate form any agreement they may choose to make as to the manner in which these earnings upon the additional fixed investment should be divided? In other words, if the stockholders are willing to have one class of stockholders accept a low interest bearing, well secured, preferred stock, in consideration of the cash paid in, who could object if they wished to issue an additional amount of common watered stock, upon the basis of which the surplus earnings would be divided? To prevent this, would be to discriminate against this class of corporations alone.

The justification for such action surely would not rest upon the theory that the public purchasers of such stock require protection, for if the protection of the public purchasers of stock is the object to be attained, then surely the capitalization of all corporations should be limited in the same manner as the capitalization of public utility corporations. Neither can the limitation of the capitalization of public utility corporations be justified upon the ground that the public is entitled to some protection against monopoly, for the power conferred upon these commissions to regulate the prices provides this protection. Nor can it be said that such regulation should be applied to public utilities alone in consideration of the use of the streets, for every corporation, and all the public, being guaranteed the use of the streets, and the exercise of the power to regulate the relation of a public utility corporation to the public is exerted in consideration of the

granted use of the streets. It, therefore, appears impossible to explain upon what theory the application of such rule as this should be made with respect to public utility corporations alone, as distinguished from all other corporations. There is none, unless it should appear upon consideration that the exercise of this right would tend in some manner to improve the service and to reduce the price of it. It is my opinion that the contrary effect would be produced by the exercise of such right.

In the development of any new enterprise it is almost always the case that one man possesses the knowledge of the business, and the opportunity for entering it, and that other men furnish the capital to prosecute it. It is generally true that the man who possesses the knowledge of the business lacks the capital. He possesses, however, the confidence of his friends, who have the capital. In addition to his knowledge, he possesses enterprise and good business judgment, and his friend, or his friends, are willing and anxious to commit their money into his charge. Under these circumstances, the arrangement which he will propose will be such, as under similar circumstances always has been proposed to men of capital, that all the property purchased by the money invested should be held for the security of the men putting up the capital, and that the one who finds the opportunity, and assumes the management, should have his compensation in a portion of the profits earned over and above the interest on the capital invested. In every commercial age of the world this has been considered a fair and equitable arrangement. The inventor, the manager, the organizer, the promoter—whatever you may call him—the man who puts his knowledge and time and effort into the business, seeks to make a proposal under which, if the enterprise should not be successful, he would receive no compensation, and if the enterprise succeeds, he would receive a compensation measured only by the extent of the success. In fact, this appears to be the only fair arrangement, for if the man possessing the capital should give to the promoters of new enterprises a proportionate interest in the property purchased, the promoter would then be certain of a profit, though the capitalists might sustain a loss. It might even be to the advantage of the promoter and manager to allow the company to suffer. Where the promoter-manager receives his compensation only by sharing in the profits over and above the interest on the investment, it is certain that his utmost efforts are stimulated to achieve success.

An arrangement conducing so obviously to the protection and profit of the inventor, and to the profit of the organizer and manager, is of the utmost advantage to the community at large, for it tends to the development of the resources and business of the country. First, because of the rewards that are offered it stimulates the activity of our most enterprising men to overcome the timidity of capital and apply it to the development of resources; second, because it stimulates the utmost efforts towards good management.

Now, whatever may be said of the abuses of this custom of issuing watered stock, the universality of its use is occasioned by the fact that no contract, embodying the relationship which has just been described, can be written into corporate form without the use of watered stock. The manner in which this contract might be expressed in corporate form would be by the issuance of an amount of preferred stock equal to the cash invested, and all to be delivered to the men supplying the capital, and by the issuance of an additional amount of watered common stock, of which a portion should be delivered to the promoter, and the remainder to the men furnishing the capital.

Corporations are organized to embody, and do embody, in permanent form, the most varying and intricate partnership relations, by the issuance of bonds and of the various classes of preferred stock, and of common stock, any partnership agreement may be written in corporate form. To limit the capitalization of corporation to an amount equal to the cash paid into the company, would render it impossible to write in corporate form a very large and important class of partnership agreements, and it would not guarantee the actual value of the stock issued. The par value of the stock has little or no connection with its actual value, whether or not the full amount of cash has been paid into the company. The moment this cash is invested, it becomes worth either more than par or less than par; for the enterprise will be successful, or it will not be. The function of a stock certificate is not to determine values, but to define relationships and to fix proportionate ownerships. The purchaser of a certificate of stock, to ascertain its value, must inquire into the value of all the property and rights held by the corporation, and into the total issue of the stock against the ownership. It has been suggested, and with much force, that all of the essential functions of stock could be performed without the designation on the face of the stock of any fixed amount in dollars. If a stock certificate certified to the ownership by the holder of a certain number of shares, stating the total number of shares outstanding, and without containing any references to the value whatever, such a certificate might, and probably would, perform all of the services now performed by stock certificates. If such a device were adopted, there would probably be no discussion as to the watering of stocks, for, as I have stated, the proportionate ownership is the essential factor. Regulation by government will not protect the ignorant or the injudicious purchaser of stock, and I do not believe that the limitation of capital would ever protect the public against the effects of its own unwillingness to investigate.

At the same time, to forbid the issuance of any unpaid stock, as I have attempted to point out, would close one door of ambition to young men of ability and enterprise, and prevent them from making arrangements, through corporate activity, to share in the profits of their own efforts. Watered stock is the device that emancipates men who have shown ability and initiative, and who, by long and arduous apprenticeship, have gained the confidence of capital; emancipates them from a lifetime of irksome subordination, and opens to them a lifetime of independent activity. No young man of ambition and self-reliance could willingly consent to its abolition. I will venture the assertion that nearly all of the men independently successful in commercial life to-day, who have risen from poverty, have accomplished their success through some such device which has enabled them to share in the earnings of their own activity. If they worked through corporations, they have attained success by getting control of watered stock.

By this method of issuing stock, the reward has been held out for enterprising men to seek idle capital and persuade it into investment. If it should be eliminated, the process would be entirely one of capital seeking its own opportunity for investment. By this method the brains and energy and enterprise of our country are capitalized. The breaking of the alliance between the promoter and the capitalist would increase the amount of idle capital and bring about such conditions that men would have to devise some other method to accomplish the same result. I shall not deny that the privilege of issuing watered stocks has been abused, that over-capitalization has been made the basis of misrepresentation, but the over-issue is not misrepresentation; deceit may be practiced in either case. The over-issue of capital may also be abused, and has been abused, at times, by locating the control of property where it does not legitimately belong. But surely some method of correcting such abuses could be devised without utterly destroying an instrumentality of such great convenience, both to capital and enterprise.

The same discussion has taken place in other governments where the same abuses had occurred. After a controversy, in which benefits were forgotten and injuries exaggerated, it was found, in England at least, impossible to proceed without some injection of watered stock, designated in that country by the term "Founder's Stock," and in recent years expanded by the so-called "Profit Sharing Certificates." This may be the correct solution, the issuance of stock without the dollar sign may be the correct solution, or some other better suggestions may be made.

Whatever may be the decision, however, as to preventing the issuance of watered stocks, to apply such restrictions to public utility corporations alone would at once deprive those properties of the activity of those men who have in the past induced the investment of capital in these industries, and divert their activity to corporations in other lines of business, which could continue to offer them the desired rewards in common stock.

I may perhaps make myself more clear by a single illustration of the formation of a gas company under these laws. Let us suppose that the amount to be invested is $100,000. If the laws forbade the issuance of watered stock, the company might be organized in a variety of ways, as, for instance, by the issuance of $50,000 of bonds and $50,000 of stock, or by the issuance of $100,000 of stock. Under the law all of this stock would be limited, let us say, in its dividends to 10 per cent., but though the law may limit the dividends to 10 per cent., the law cannot guarantee that the company would earn its 10 per cent. These men, contemplating investment in such stock, would, therefore, endeavor to secure as presidents of their companies, men of sufficient experience and business judgment to assure the success of the enterprises. But they could offer him no inducements beyond the inducements of a salary, and the opportunity would be open to the man they sought, in other fields of corporate activity,

where he would be given an equal salary and a portion of the watered stock, which would enable him to share in the profits of his own activity. And so it might easily happen that, because of their inability to secure a satisfactory man to take charge of the property, they would abandon the enterprise. If, however, the law permitted the organization of a company under these circumstances, with $100,000 of preferred stock, guaranteeing 6 per cent. dividends, and $100,000 of common stock, the dividends upon which, under the exercise of the right to regulate prices, could never exceed 4 per cent., making a total, as in the first case, of 10 per cent. in all upon the cost of the investment, they would be able to offer such an attractive inducement to the man in charge of their interests, as to secure the highest grade of services. In fact if this latter course were open, the opportunity for such an investment would be brought to their attention by this man, and capital, which under other circumstances would seek other fields of investment, would be drawn into this line of business. If, therefore, other corporations are permitted to offer this inducement to enlist the activity of promoters to attract capital, and public utility corporations cannot offer this inducement, the capital which heretofore has been invested in public utility corporations would probably seek other lines of investment.

If I have made myself clear, I have justified the position that the exercise of the right to limit the capitalization of public utility corporations to the amount of money paid into the companies, may tend to check the flow of capital into these investments. It will be admitted that any conditions tending to limit the flow of capital to these investments, would tend, by checking extensions, to prevent a large portion of the public from receiving any service, and thereby increase the cost of the service to the remaining portion of the public.

I know of no better method of testing the value of these theories I have endeavored to explain, than to compare the conditions that exist where these laws have been in force for the last 10 or 12 years, with the conditions existing where no restrictions whatever have been put upon public utility corporations.

I compare Massachusetts with Illinois or Michigan. In Massachusetts the public utility commission has been in force for 12 years, during all of which time the operations of these companies has been subject to the closest scrutiny by the Commissioners, and the utmost efforts have been made to improve and extend the service, and to lower the selling price. The economic conditions in Massachusetts, where freight rates justify the universal manufacture of coal gas, the existence of more large centers of population, and the more developed systems of transacting business, would all conduce to the establishment in Massachusetts of lower selling rates and larger consumption of gas than would be expected in Illinois or Michigan. As contrasted with those conditions in Massachusetts, it must be remembered that in Illinois or Michigan the operation of Public Utility Companies has, up to the present time, been subject to no regulation, and that the motive which has produced a lower selling price and a larger development of business in these States, has been the selfish and natural one of seeking the largest possible net earnings.

I quote from the Twenty-third Annual Report of the Board of Commissioners of Massachusetts for the calendar year of 1907, giving the annual returns of companies for the year ending June 30, 1907: "The average price paid by consumers for gas, to the companies selling annually more than 30,000,000 feet each, is 92.3 cents. If the Boston Company be excluded, the average is 98 cents. The average price received by the remainder of the gas companies from sales by meter, is $1.58; the average received by all is 94.8 cents.

I have taken these figures and compared them with the results in Illinois and Michigan, as compiled by the reports of all the gas companies in these States, securing the greater part of this information from "Brown's Directory," for the year ended December 31, 1907:

	Massachusetts.	Illinois.	Michigan.
The average price paid by consumers for gas to the companies selling annually more than 30,000,000 feet each is	$0.923	$0.885	$0.869
The average price received by the remainder of the gas companies from sales by meter is	1.58	1,297	1,185
The average received by all is	0.948	0.891	0.897

The following is a comparative table of the annual per capita consumption:

	Massachusetts. Cubic Ft.	Illinois. Cubic Ft.	Michigan. Cubic Ft.
The average annual consumption per capita by consumers of gas for the companies selling annually more than 30,000,000 feet each is....	4,418	6,409	5,633
The average annual consumption per capita of the remainder of the gas companies is	988	1,662	1,783
The average annual consumption per capita of all is....	3,951	6,061	4,773

I do not offer these tables as establishing an absolute proof of my contention. Very many circumstances affect such results, but I do believe that I have mentioned the controlling one. I believe that the establishment of the right to regulate rates, if judiciously exercised in Illinois and Michigan, would lower the selling prices materially. If the exercise of this right should be accompanied by the exercise of the power to limit capitalization to the exact amount of cash expended, I should expect neither a material reduction of selling prices, nor any material extension of the service.

Heating Machines.

[Prepared by Mr. E. P. Reichhelm, New York City.]

The designation, "Heating Machine" is a comparatively new technical term, applying to the ever-increasing number of mechanical heating devices designed to do the work of furnaces in connection with machinery. For instance, for heating large quantities of work of a specified kind and size, and to discharge the same uniformly and properly heated for annealing, hardening, tempering or forging.

Such heating machines are of great variety, since each one must be specially designed or modified for each particular kind of work, for any great variation in size, weight, or shape necessitates a different construction. There are no "heating machines for general shop work," but only such as will treat quantities of one kind,

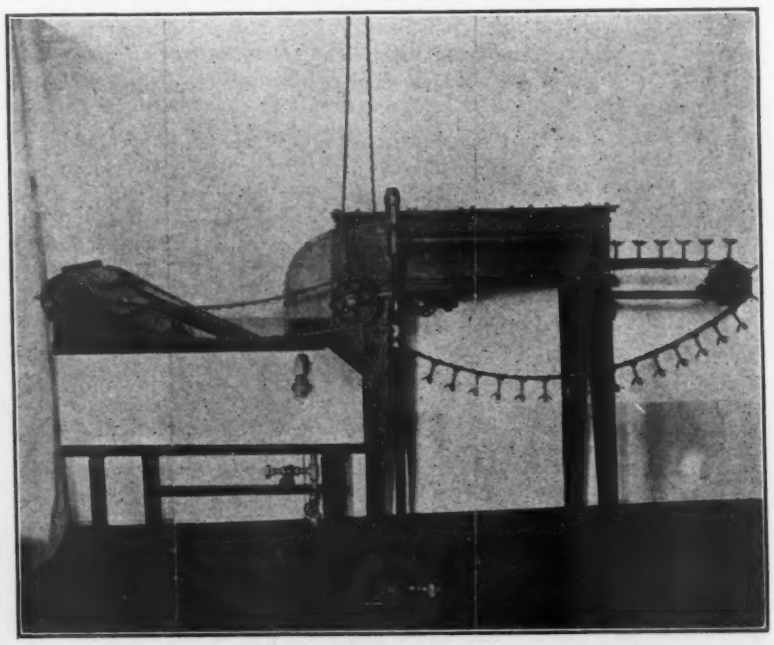


Fig. 1

not greatly varying in dimensions. By far the greater number of machines in practical operation are designed for the annealing, hardening and tempering of large quantities of small work; and a very important use of heating machines is made in the new "Case Hardening Process," where gas takes the place of solid carbonaceous matter in transforming the exterior of low-grade steel into a high-grade tool steel, for surface hardening.

To a limited extent, heating machines are used for forging, but only where large quantities of rods of the same size are to be

heated to supply power presses or hammers with a specified number of properly heated pieces per minute.

In the annealing of small brasswork such as cups, ferrules, shells and small tools, a heating machine is especially applicable, and of great advantage. It turns out perfectly annealed stock for further treatment in punches and dies, securing a uniform and even displacement of the metal in punching or drawing it, thus prolonging the life of the dies or punches and increasing the percentage of perfect work obtainable from a given amount of metal.

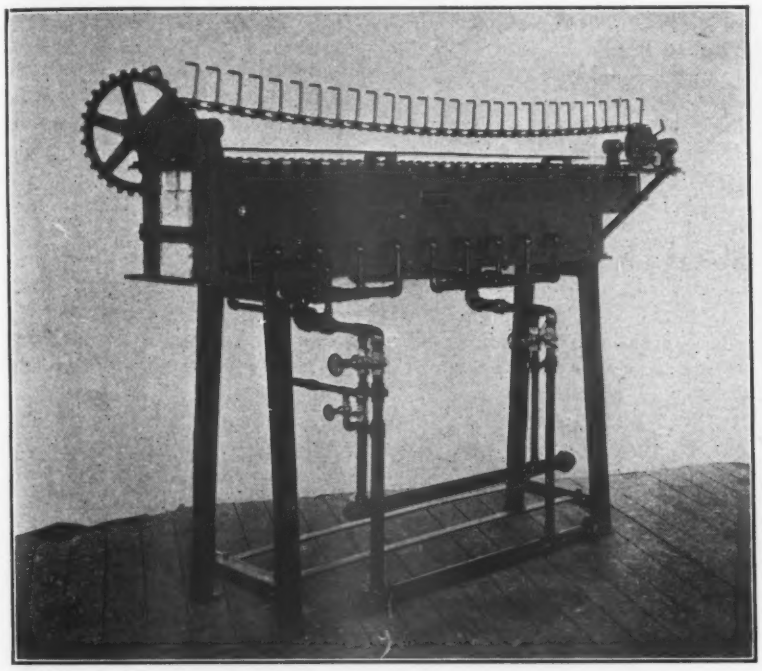


Fig. 2

Machines are used for tempering small work, such as chain links, and usually operate with sand kept at exactly the proper temperature for the temper or color required, the heat applied being properly adjusted by reference to the thermometer.

Fig. 3

This article being intended merely to direct attention to some recent developments in the use of gas as fuel, the following descriptions are confined to a statement of principal features of a few of these machines now in successful operation, offering advantages in special kinds of work, not obtainable by the use of any other fuel than gas, when economically and correctly employed:

Machine for Annealing Watch Cases.—The blanks are placed on the carrier to the right of the cut, at the rate of from 40 to 60 per minute. They are dropped into the cooling tank, from a hooded discharge on the left, and thus carried by the linked trays, out of the bath, as shown in the cut in Fig. 1.

Machine for Hardening Rings, Washers, Pinions, etc.—In fact, for any kind of small pieces containing a hole, so that they may be hung on hooks, shown in the cut, just before entering the heating space. The work travels on these hooks through the furnace at the exact speed required to heat it properly for hardening, and, on reaching the discharge, the work drops into a quenching bath placed under the hooded discharge, shown on the right.

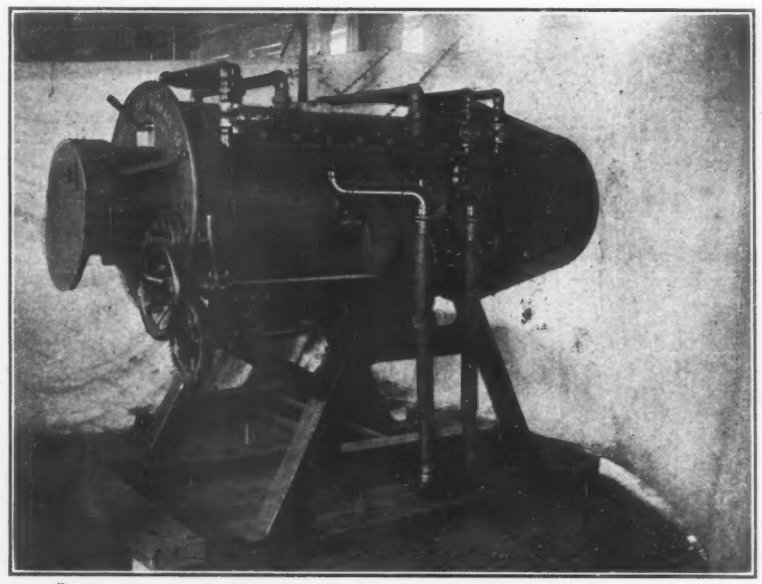


Fig. 4

Machine for Tempering and Coloring.—This machine performs a great variety of work, including such delicate work as steel pens. It is also used for imparting the lustrous black finish known as "Carbonia," well-known to manufacturers of small arms, buckles, buttons and various other kinds of small articles, requiring a nice, non-oxidizing finish.

The work is placed in a bottle-shaped revolving retort, and, under a properly regulated heat shown by the thermometer, the work will be discharged with perfect uniformity, and of the temper color desired; or, if used for the "Carbonia" finish, uniformly colored. The discharge is easily effected by tilting the furnace by the end of the handle shown in cut.

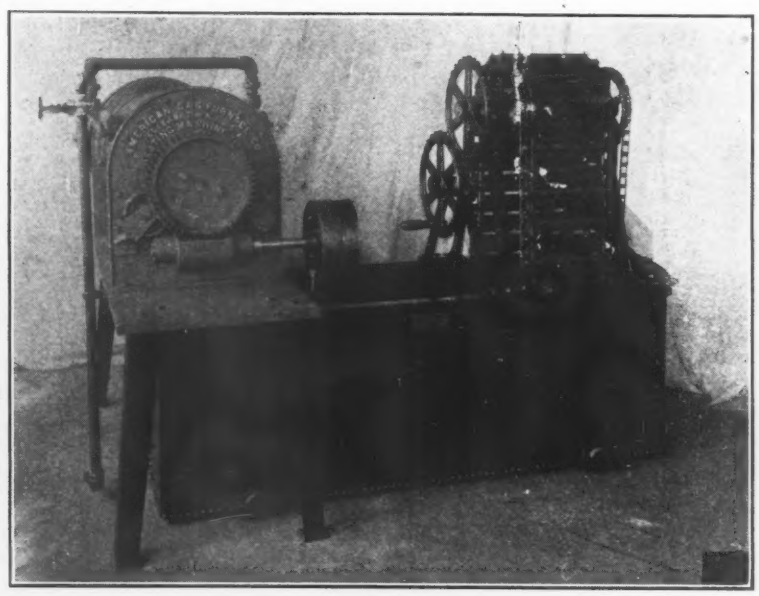


Fig. 5

Machine for Annealing Large Quantities of Brass and Copper Shells.—The work is placed in the hopper, to the right in the cut, and discharged from the hood on the left. The travel of the work through the retort can be very accurately regulated by tilting the whole body of the furnace in either direction, so as to either retard the travel through the retort or to accelerate it.

The tilting is easily and accurately accomplished by using the hand-wheel shown in the cut. Recent machines of this kind, built for an hourly output of 600 pounds, exceeded the requirements.

Heating Machine, in Combination with a Quenching Bath.—The apparatus is especially applicable in the manufacture of ball bearings and other small work requiring very accurate treatment, and in which the quenching of the heated steel is quite as essential as the proper heating.

The principal feature of this quenching bath is that it keeps the work in motion and well separated, whereas the dropping of such work into an ordinary tank would make it liable to become bunched, retaining the heat longer than is permissible, thus producing an uneven hardening.

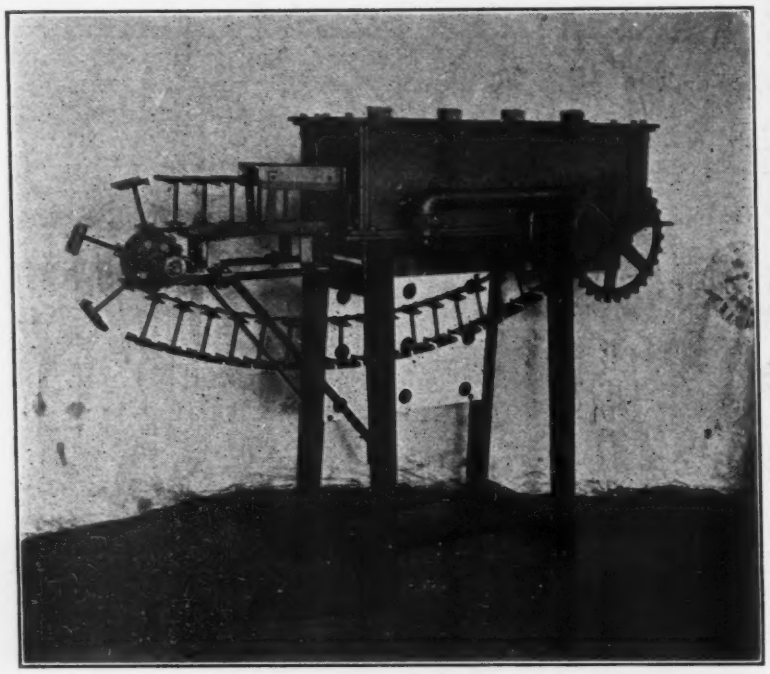


Fig. 6

Machine for Hardening Needles and Other Thin, Light Work.—The work is placed on the nickle trays shown in the cut, mounted on an endless chain. The trays only are exposed to the heat in the heating chamber, traveling on pins through a slot in the bottom, fixed on the chain links, which travel in the open air beneath the furnace, thus making a very durable and efficient machine for such work.

The Story of the Journal.

(*Continued from page* 169.)

York, N. Y., Philadelphia, Pa., St. Louis, Mo., and Williamsburg, N. Y., and the like, as now, and have been for many years, reaping rich harvests. Their shares range from 120 to 225 per cent. above par value, and they ought to bear the brunt of a burthen which, if laid upon the weaker companies, will shut out from the blessing of light whole communities that really cannot afford to meet the emergency." The force of this seems to have appealed to Congress, for later on the bill was altered into a graded one, quite like the following:

Quantity made per month.

Cubic feet.	Tax per 1,000.
500,000	5c.
Over 500,000 but under 5,000,000	10c.
Over 5,000,000 but under 15,000,000	15c.
Over 15,000,000	20c.

Another line or two at this point to show that coming events cast their shadows before, with noble aims. The lines are these, the date in mind, August, 1862: "The new tariff which increases the duty on foreign gas coal, and the tar bill, which likewise imposes burdens upon coal gas and the materials from which it is made have strengthened the interest felt in petroleum, and it is quite likely that many companies will be disposed to experiment upon a mixture of the two materials by which the cost of their product may be reduced." And these experiments were carried on forthwith and at great length. Another material that was called upon largely, especially in the Confederate States, was rosin. On August 1, 1862, the Manhattan Gas Light Company, through its Secretary, Mr. S. H. Howard, announced that the price of gas would be increased to $2.35 per 1,000 cubic feet, an increase of 15 cents per 1,000, or sufficient to put the war tax squarely on the consumers; and this was immediately followed by a like notice from the Troy (N. Y.) Company to the effect that thereafter the consumers would be called on to pay $3.10 per 1,000 for gas—just the excess listed on their output by the Government tax. Again, the JOURNAL came to the front, when, likely begging the question would have ultimately proved vastly more profitable to its proprietors. In a lengthy article commenting on the procedure of the Manhattan, the old war horse had this to say: "We cannot but regard this step of the Manhattan Gas Light Company as very impolitic, and one which is and will prove to the stockholders the injudicious nature of the change. We do not by any means question the right to increase the price. Of this there can be no doubt; but merely as a question of expediency, we deem the action hasty and ill-advised." It is well worth while to read this article, which was printed in the issue for September, 1862. Shortly after the New York Gas Light Company followed suit, as did several others throughout the country, the old Brooklyn (N. Y.) Gas Light Company included.

In the number for September 15, 1862, the JOURNAL, in commenting on these increases said: "It is useless to mince words about this act of the gas companies * * * that it is the coolest piece of imposition ever attempted by corporations upon an intelligent people." However, it went on just the same, but not for long. The outcry raised by pulpit, press and citizen was such that retreat was speedily in order; in fact, as early as the following October, Troy and Albany, N. Y., and the New York and Manhattan companies put the gas rate at its former figure, promising to keep it there until they were unable to pay a dividend equal to 8 per cent. per annum. Meanwhile, the price of coke had been advanced 50 cents per chaldron and to 20 cents per bushel. It is queer to note how this subject appeared to the sight of our English brethren, the Journal of Gas Lighting found exceeding fault with our JOURNAL regarding the stand taken by us anent the income tax, inasmuch as that directly concerned certain English investments. The English comment, made late in October, 1862, was very severe in that it questioned the companies' acts in discussing selling rates to the utmost, but the meat for the foreign tooth was undoubtedly in the line of the sore cry.

"The coupons of some American bonds, of which we are holders, realized a year ago, 4s. 1d. per dollar in, but now the best price offered is 3s. 1½d." Of course the foreigners could see no reason in reprehending the increase in gas prices, although many of the consumers were suffering from a loss of all that they had invested in hundreds of varying types of bonded securities in both of the Union and Confederate States. At about this period American gas coals were beginning not only to attract attention, but were being put on the market in increasing quantities—the high prices for foreign coals and the inability of the English shippers to successfully run the blockade causing scant supply—and even in those early days American gas companies were not slow to acknowledge the vast superiority of the coal of the Westmoreland Company's mining over the material that had been shipped from England and the Province of Canada. The trials for water gas up rearing now were naturally many, and the JOURNAL for 1863 contains an article on the "History of Water Gas" up to that time, which, read in conjunction with Mr. F. N. Morton's story of the subject up to date, told in our Semi-Centennial number, shows the speed that was then making for a successful fruition of that system. The signs of the times here point to serious trouble having overtaken the banking concern of J. B. Murray & Co., for with the issue of January 1, 1863, the name of that concern no longer appears as proprietor, both the business and editorial direction having been concentrated in the name of C. Elton Buck. Mr. Murray had gone largely into that business, which he advertised as an "Army and Navy Pay and Claim Office"; his headquarters had been in the offices of the JOURNAL. To go back a trifle: The Harlem Gas Light Company was organized to do business in New York, north end, in 1857, with a capital of $400,000, under the presidency of Burr Wakeman. In 1863, it was a prosperous concern and was paying dividends at the rate of 10 per cent. per annum. In 1861 the Metropolitan Gas Light Company was formed as a competing concern with Mr. C. H. Sand as its first President. It did not start supplying gas until late that year, but the menace of it all was so great that before actual hostilities in rate cutting had commenced, the Manhattan Company sold to the Metropolitan the new plant which the former had constructed at 16th street and North River, and the city was thus districted: New York's territory between the Battery and Grand street; Manhattan from Grand street north to 34th street; Metropolitan, 34th street north to 79th street; Harlem, 79th street north to 230th street west, to Harlem bridge east, the total capitalization

of these companies being $7,100,000. The rates charged by the respective companies in 1863 were: Harlem, $3; Manhattan, $2.50; Metropolitan, $2.50; New York, $2.50. The war was now lagging, but it was only the lull that precedes greater ravage or final ending. However, the unrest of the turmoil was being fairly felt in the business centers of the North, and an instance in connection therewith was the attempt in New York City in July, 1863, to destroy the gas plants, the failure to even palpably harm which was mainly brought about by the courage and clear coping methods going therewith shown by General Roome and Joseph A. Sabbaton—the latter was Engineer of the Manhattan Company. And it is a strange feature of the turmoil that the animosity of the mob seemed chiefly directed against the Manhattan Company, which corporation never neglected an opportunity to advance the welfare of its men.

In October, 1863, the JOURNAL sounded the first hint of the possibility that perhaps the days of arc electric lighting were nearer than even the most progressive scientist hoped. Indeed, the article on the "Electric Light" (JOURNAL, 1863), would teach that its advent was not far off. Another most interesting thing in this connection is the troubles that were being experienced by the oil men. The production of crude was coming in at a tremendous rate. In fact, our advertising columns were already showing the importance of this new trading, in that the financing of oil companies, the manufacture of oil lamps and the like were being shown in the normal channels of the lighting trade. The number of the JOURNAL dated July 1, 1864, was the announcer of important changes in ownership and history. All connection with the paper, so far as John B. Murray was concerned, was at an end, for, although no public mention of his name had, as was earlier stated, been made for two years or more, he now parted with everything connected therewith. Bad investments had obliged him to dispose of many things; of the latter the JOURNAL was one. The July 1 issue was published under the name of THE AMERICAN GAS LIGHT JOURNAL AND MINING REPORTER. Its staff was thus composed: Editor and Proprietor, James W. Bryant; Publisher, W. S. Sherman; Consulting Chemist, Dr. C. Elton Buck, and its headquarters were in 15 Nassau street. The subscription and advertising rates remained unaltered, and its objects were to treat of "Light, Heat, Mining Interests, Petroleum, Water Supply and Scientific Subjects generally"—truly quite a maze of matter to be handled by Messrs. Bryant, Sherman and Buck.

The new management certainly had their own ideas about how to present all these matters creditably; but we fear the get-up of the paper was rather messy; for instance, copper and petroleum shares were regularly quoted. Mr. Bryant had been a broker in his way, and was likely one of the type now designated "the curb." However, things went on well for quite a while, a large portion of the space being devoted to gas engine practice, the practicability of the Lenoir gas engine having then been well proven.

It was at this time that Professor Henry Wurtz's name appeared as a constant contributor. He contributed the matter for each number that appeared under the standing sub-head "Scientific Intelligence." He also contributed frequently editorial articles, notes on special subjects (chiefly chemical), etc. In this volume (No. V.) the Eagle gas stoves were advertised by H. D. Blake, New York. That Professor Wurtz was well up on the subject of water gas is well shown by an excellent monograph thereon in the issue for August 16, 1864.

Another change in the titling—and a radical one it was—was announced in the issue dated October 15, 1864. The publishing dates were changed from the 1st and 15th of each month to the 2d and 16th days, and the title to that of THE MINING AND PETROLEUM STANDARD AND AMERICAN GAS LIGHT JOURNAL. It was anything other than a gas paper then. Indeed, one of its leading editorials, initial issue, had to do with "The Philosophy of Bathing." What a medley its advertising columns! How lacking in gas news its general columns! As a sample of the first instance, side by side were these "ads" of this nature: P. Munzinger, Engineer of the Philadelphia Gas Works, advertised a lot of second-hand cast iron, round purifiers; and next it was the announcement that Kent's East India coffee was for sale at 150 Reade street, New York. This by way of illustration.

In the fall of 1864 Mr. Mills L. Callender, an inventor of note, whose chief claim to prominence in the line of inventing up to that time was connected with the Callender "No Chimney Lamp," and with a method of armor protection for war vessels that had attracted the governments of the United States and Brazil, secured the New York agency for the "Thompson Patent Gas Controller," which appears, had the endorsement of such gas men as Colonel (that was his then title) Charles Roome, Peter Cooper, J. K. Simpson, A. L. Bogart, Colonel A. J. White (father of the late Captain W. Harry White) and engineers of the Metropolitan Gas Company and others. Naturally, this connection brought Mr. Bogart and Mr. Callender in close touch, the latter using the advertising columns of the JOURNAL quite freely.

In November, 1864, the publication offices were removed to the Tribune Building, No. 1 Spruce street, meanwhile the moving spirit seemingly being petroleum rather than gas. Peace had been declared before anything of especial importance in the printing of the JOURNAL had occurred. Price for gas had gone to $3.50 per 1,000 cubic feet on account of still further impositions of a war tax that now amounted to $1 per 1,000—gas coal in New York City, in 1864-5, had gone as high as $23 per ton.

The first time in its history, the JOURNAL was draped—i. e., printed with head rules and editorial page rules reversed, showing the wide base of the rule instead of its top—was the number dated April 17, 1865, the Great and Good President of the United States, Abraham Lincoln, having been ruthlessly murdered three days before, Friday, April 14, 1865. It is but a step from awe to its antithesis, but we do not find that 1865, although it evidently must have been a good one with proprietor Bryant, from an advertising standpoint, differed much in its advertising sources, for side by side we find reposing announcements regarding Worthington's patent water meters, and Hubel's "Golden Bitters." But even then impending changes were in the air. The first outcome of these was the appointment to the editorial staff of Dr. Charles W. Torrey, whose fame as a chemist was international. Again the uplift of the horrid embargo of civil war was quickening. The ruined gas plants of the South had to be rebuilt, and the growth of those in the East, North and West was amazing. People having been accustomed to the advantages of gas, were loud in their calls for its proper supply. To meet this demand the shops and foundries and supply houses of the country were rapidly adapting themselves. Brilliant as a chemist, as an editor his ways were not keen or positive.

Appreciating this quickly, he was adverse from the first to try out the task; he retired from that line of work with the issue dated February 2, 1866. One month later, Mr. Bryant associated with him the late Mills L. Callender as editor, the former's state of health (he had long been a sufferer from pulmonary trouble) becoming such that an associate was a matter of absolute necessity. From the very outset the tone of the publication changed, and gas again came in for the major share of attention. In the first step in this change Mr. Callender also took over the duties of publisher, Mr. Sherman going out from the concern completely. Things progressed with smoothness and on July 2, 1866, the announcement was made that after such date THE MINING AND PETROLEUM STANDARD AND AMERICAN GAS LIGHT JOURNAL would thereafter be published on the 2d and 16th of each month at 22 Pine Street, New York, under the firm name of Bryant, Callender & Co. Mr. Buck remained in the capacity of consulting chemist, and associated with him was Prof. R. M. Partz. Continued improvement was manifested both in respect of its reading matter and the typography. The paper at this time, as it had been since 1860, carried 16 pages. It should also be noted that Prof. Wurtz again figured as an active and prominent contributor. The death of Mr. Bryant, March 20, 1868, resulted in the taking over of the paper by Mr. M. L. Callender, who operated it thereafter under the title of "M. L. Callender, Editor and Proprietor." Now the paper took on substantial strides and made great progress. Mr. Callender was a man of no mean mental resource, had the courage of his convictions and the ability to convey them to the minds of others. Tall, spare, melancholy, the picture given herewith affords a good resemblance of him.

He was not well equipped physically for strife with the world, but his indomitable spirit kept him moving when many another would have given up the combat. To begin with, shortly after his advent to the proprietorship the title of the paper was changed to that of "THE AMERICAN GAS LIGHT JOURNAL" and its purposes as stated were devoted to "Gas, Light, Water Supply, Mining, Petroleum and Scientific Subjects." In the issue for October 16, 1868, first appears regularly the name of Prof. Henry Wurtz, who shortly afterwards started and edited a department in the JOURNAL under the head of "Chemical Repertory." During this period the paper grew rapidly in importance, as its advertising pages amply attest. Matters connected with the JOURNAL moved along smoothly and successfully in 1868 and 1869. It increased in value both to its readers and proprietors, its mentionings with respect to gas matters being vastly bettered. The number for October 2, 1869, is notable for an illustrated description of the Cambridge gas stove,

intended for the heating of houses, or parts thereof, which apparatus, to our mind, was the first in this country to attract more than passing attention, or to be employed in a practical way over a fair stretch of time. In 1869 the publishers commenced the printing of two volumes each year, dating same from January to July and from July to January, the purpose of the change being for convenience in handling, etc. It was in 1869, too, that the Gwynne, Harris hydrocarbon process was largely advertised, the result being that before the close of the year installations had been made at the works in New Haven, Conn.; Westchester, N. Y.; Utica, N. Y.; Newark, N. J.; and Elizabeth, N. J.; in fact, in the latter place it had been tried out one way or another since 1867.

In January, 1870, the late Charles E. Sanderson entered the service of M. L. Callender & Co. as office man and bookkeeper, and a decided acquisition he proved. System, method and application were sensibly devoted to the conduct of the business from mercantile standpoints. The result was soon apparent in increased and increasing demands for the paper, and its influence for good in the industry was becoming pronounced. Schemers with schemes multifarious were located and watched, with the result that owners and engineers frequently met in our offices to compare notes as to this and to that. The growth of the paper had now reached the point where it was necessary to secure larger quarters, and these were secured, May 1, 1870, when offices in the then modern buildings belonging to the Hoyt estate, at 40, 42 and 44 Pine Street, were leased. At this period Mr. Callender was largely concerned with inventive matters as an attorney for patentees, etc. The year 1870 was generally uneventful, save for the fact that the increases in the number of companies projected and in course of construction were sufficiently large to attract the attention of capitalists, and the study of prospectors. In this year, too, the purification of gas by means of oxide of iron, properly prepared, was brought out by Emerson McMillin, who at that time was Superintendent of the Ironton (Ohio) Gas Light Company, as were the gas cooking and heating stoves from the designs of Mr. A. L. Bogart, of New York. Another noteworthy happening in 1870 was the engaging of Mr. William Farmer (he had been engineer of the Manhattan Gas Light Company for some years) in the business of "Architect and General Gas Engineer," with offices in the JOURNAL'S headquarters. The most important work done by him in this connection was the designing and constructing of the works of the Laclede Gas Light Company, St. Louis, Mo., in 1871. Mr. Farmer, who gave to the gas world the benefit of his famous "Farmer's Theorem" in the early '70s, is, according to our last advices, alive and well at his home in the Brockton House, Ancaster, Canada. At any rate, his copy of the JOURNAL is mailed to him regularly. This is really a world's wonder, for he certainly is not less than 100 years old. The year 1871 was a notable one in the gas annals. James Barnard Blake, Mayor of Worcester, Mass., and engineer to the Worcester Gas Light Company, was killed by an explosion of gas that occurred in the works the night of December 16th, 1870, and his death seemingly wrought great conversion among the practices of the engineers of that time, particularly in New England, New York, New Jersey and Pennsylvania. Heretofore their works were as the entrances to fortresses. Thereafter, anyone at all suitably introduced, found them open wide. Along, too, came the New England Association of Gas Engineers, whose methods within a short space were of such nature that in a comparatively limited period the people of the gas works found themselves akin.

We had occasion, in mentioning Mr. Callender's private connections with the JOURNAL, to note that he was not of the robust order, and now it may be said that his devotion to duty was the cause of his death. The winter of 1870-71 had been a very distressing one, and the spring was also very backward. Late in the winter of the year in question a huge coal pile in the yards of the Brooklyn Gas Light Company took fire from spontaneous combustion—if we mistake not the main contents of the pile was coal from Cape Breton. The mass, which measured perhaps 2,800 tons, was well afire in the center, and, in fact, after days and nights in attempting to extinguish the flames by ordinary means the pile had to be pulled apart. The second afternoon of this conflagration (it was in the sheds, foot of Hudson Avenue, Brooklyn, N. Y.) Mr. Callender visited the scene. The result was that the cold from which he was suffering, through his exposure to the chill atmosphere at his post of inspection, intensified the same to the pneumonia point; from the ravages of which he died on the 21st of February, 1871. We can hardly add anything here to that which we said about him respecting the time he became connected with the JOURNAL, although to that we may properly add that it was to his judgment, prudence and method that the fortunes of the JOURNAL had been brought from out a veritable slough of despond to the highway of success, a result accomplished in less than three years. In the interim the editorial management was tentatively under the control of Prof. Henry Wurtz. In April, 1871, the business was taken over by A. M. Callender & Co., and on the 3d of July following Professor Wurtz was appointed to the post of editor. The JOURNAL thrived well under this management and direction, but there were in the air (yes, almost everywhere) rumors of trouble in the industry. The financial end of the business was loath to cut down war rates, and the constructors of gas works material did not care much over the situation. They were getting high figures for constructive work whether that was either "new" or "repairs." So, as between the owners and constructors things looked quite easy. They overlooked, however, that the speculator is ever in the land, and it was not long before some of the sharper specimens of that family determined that gas at $2 to $3 per 1,000—and a 16-candle coal gas at that—afforded a fairly good opening for competition. And they seized firmly their opportunities for investigation. Meanwhile the members of the profession generally were getting together in closer relations. The organization of the Gas Light Association of the United States (afterwards the American Gas Light Association) was perfected in New York City, the 16th of April, 1873, the chief executive officer being Gen. Charles Roome, and the initial secretary was Prof. Henry Wurtz. In fact, if due credit were given to the originators of this movement, none should receive fuller measure than Professor Wurtz, for in and out of the JOURNAL, he was constantly urging the fruition of the movement to form a national association. Wurtz, however, was a very punctilious man, irascible to the extreme, and with a full knowledge of all that should come to him as reward of his labors. Right at the start he managed to antagonize the leaders in this movement, and at the first national meeting, held in New York, October 15 and 16, 1870, Mr. P. E. DeMill of Detroit was named to succeed Prof. Wurtz as Secretary. But, to the record. Petroleum continued the thorn in the gas makers' bush, and Messrs. Rice and King and others were constantly improving the ways of refining it. The brothers Rockefeller, Wilson, and others had, in fact, by this time, gone far towards outlining the company which in comparatively short time was destined to control the petroleum trade of the world. Strange to say, the most important development in the refining end of the trade was taking place hundreds of miles distant from the wells. This was on Newtown Creek, the waters of which were not of the sort that they now are. Greenpoint was on the south of it, to the north was Hunter's Point, afterwards Long Island City; both are now in Greater New York. Stacks of refineries of all sorts were here located on the salt meadows that were drained or flooded, as the case might be, as the "bosom" of Long Island Sound ebbed or flowed. And what a gathering it was. Stills of all sorts and sizes were operated by the Bedfords, McGoey, King, Engle, Pratt, McClain, Boothby, Wm. Fleming, *et al.* To name them would require a book of many pages. The outputs of the refineries per diem ranged from a 2-barrel still to stills capable of clearing up hundreds of barrels—the latter were few indeed. Possibly it might be noted here that the most advanced refinery in this section was then operated by a Mr. Engle, whose son (Robert S. Engle) afterwards became noted in New York for his connection with the distillation of alcohol. He was, by-the-way, a close friend of that sterling gentleman, Mr. William J. Logan, of the Logan Iron Works. Here, too, it might be well to note that at least two prominent gas men of that day (the late Eugene Vanderpool and the dean of the gas industry of America today, Mr. William H. Bradley) within the writer's hearing often predicted that the products of petroleum oil were bound speedily to figure largely in the artificial lighting field. In fact, in 1874, at Tidioute, Pa., one Capt. M. H. Butler had started supplying petroleum gas from a central station. However, the JOURNAL, which was bettering then, from number to number, in value to its readers, was keeping them well informed as to that which was going on in the oil fields and in the refineries. Meanwhile the gas industry was everywhere prospering, and the good work of the associations towards fraternizing the industry was becoming pronounced. As evidence thereof it is noted that the JOURNAL for the first time (issues of March 16 and April 2, 1875) published a coherent synopsis of the annual meeting of the New England Association of Gas Engineers, Tremont House, Boston, February 11, 1875.

The differences between Editor Wurtz and the proprietors which had been near the ultimate straining point for months, finally ended in the former's resignation, and the announcement of his retirement officially went forth in our issue for September 2, 1875. Major George Warren Dresser virtually assumed editorial

charge with the number for September 2, but his titling as such was not made until a month later. The Major's identified introductory, if we may so write, appears in that issue, and to-day it is well worth reading, for it holds a statement of principle and practice that have guided the JOURNAL to the present day. One extract from it will suffice to show the motives that actuated his policy: "* * * It is honestly believed that whatever conduces to disseminate knowledge of correct principles and facts, among those whose special business it is to make gas, is of service alike to consumer and maker. What the consumer wants is better light for like money. What the maker wants is to get more gas, of equally good quality, at the same or less expense of manufacture. * * *" And what shall the writer say of the Major? The writer knew him to the center of his high intellect, to the closest pulsing of his strong heart. Big in stature, bright in intellect, he was by birth, intuition, training and practice, a man of power among his fellows; withal his greatness was all the more emphasized by demeanor and conduct that caused one to esteem, admire and love him. However, no more here as to his personality, for that is well told elsewhere in this number. A half year of his editorial direction was quite sufficient to show that the JOURNAL's proprietors had made no mistake in their selection. The Major's magnetic personality was such that he was welcomed everywhere, and before the full first twelve-month was at an end, the first full force of fraternality was felt. The JOURNAL prospered, as did the industry, save that outside capital was becoming more anxious than ever to get a chance to compete with established capital. One of these was the Mutual Gas Light Company of New York—whose sponsors in the legislative line were beauties. The Major worked steadily by pen and speech to advocate the lowest prices possible for gas; but many of the fossiliferous merchants on the boards of directors negatived the well-meant and persistent efforts of their engineering direction—strange to say, the great majority of engineers were for lowering prices, even though that course meant much harder work for themselves to keep up dividends of fair amount. However, the hammering was continued; and it is curious to note now that the first of the large companies in this vicinity to make a notable cut were those in Brooklyn, which, in January, 1876, announced a reduction to $2.75 per 1,000 from $3. The New York City companies, save the Harlem (which was charging $2.75), had reached the $2.50 rate by February.

Although 1876 was considered a poor year from a financial standpoint, it may not be said that it affected the gas companies particularly, although it may not be denied that kerosene, owing to the improvement in its quality and reduction in price, aided by the fatuity of the owners of gas companies in keeping up prices, was becoming a formidable competitor. This was also accelerated by the constantly growing betterments that were being made in the devices (such as burners and lamps) for utilizing it. The paper had now increased in bulk to 20 or 22 pages the number, according to the demands that were made upon its news and advertising columns. The twenty-fifth volume (July 3, 1876) was notable for the printing of a handsome supplement. It was devoted altogether to advertising, and consisted of 16 pages of such, the illustrations accompanying the text certainly being models of the cut work done in those days. Notable in the collection were illustrations of the Patton type of petroleum gas works, and system of Lowe water gas apparatus, the sole agents for which then (July, 1876) were S. A. Stevens & Co., of Philadelphia.

In 1876 the JOURNAL had gone on to 24 pages each week, and its reputation as an aggressive advocate of the gas industry was becoming more pronounced with each number. As well it should, for to the writer's own knowledge, many an advertisement was declined, particularly those having to do with ridiculous or fraudulent schemes for making gas. Again to the writer's personal knowledge one man (he was a "big one" in those days among a certain clique of foreigners who were trying to foist their schemes upon certain companies, and carried a foreign title) was peremptorily ordered from the office, having unfolded his scheme whereby Major Dresser was to receive high reward if he would give to the man's representatives certain editorial space for favoring their schemes.

In the summer of 1877, the use of gas for purposes other than lighting had made such pronounced headway that the JOURNAL (June 2, 1877) urged the Executive Committee of the American Gas Light Association to arrange for an exhibition of apparatus for its forthcoming meeting in October. This suggestion was undoubtedly based on the great results that had followed such an exhibition, made under the patronage of the South Shields (England) Gas Company the previous April. And then came the first note of the contention that was to ensue among the gas men themselves. It came in the shape of an editorial in the issue for June 16, 1877, and had to do with the Dwight trials of the Lowe processes at Manayunk, Pa. Meanwhile the Municipal Company had been added to the New York list, and the People's, Metropolitan and Nassau companies were noted as doing business in Brooklyn—in addition to those that had been on the ground—the Brooklyn, Citizens' and Williamsburgh. It is to be regretted very much that Dwight was so potent then in water gas matters, for many a sore strife and many a burning loss would have been prevented had another sort of man been prominent in this exploiting. But as one must deal with realities, the fact is, time, bitterness and money would have been saved had Dwight been not so prominent. The celebrated "Astor House Letters" of 1877 would never have been written, and water gas would have come into its own peacefully and justly as a spur to the quickening of the gas industry. Think of it, gas-makers of to-day, the highest grade naphtha at less than 2 cents a gallon!

To prove anew that troubles never come singly, we have here to mention the second active menace to the progress of gas making—first was the kerosene; next was the electric current. The JOURNAL for August 2, 1877, reproduced, from the French *Journal of Gaslighting*, an extended account of the presentation to the French Academy of Sciences, by M. Denayrouse, of a "Note relative to the Suppression of Carbons in the Production of Electric Light." Even at this time, nearly a third of a century away, this article (it is given *in extenso*) looks a revelation. It had to do with the invention of M. Jablochkoff, which, fitted in with the Gramme machine, was to stir the world of discovery, or of invention rather, to its very center. The gas world was in arms, particularly that of England. English gas shares went tumbling; but one American coterie, headed by one of the best-known bankers of the day, did some good purchasing of South Metropolitan and Gas Light and Coke Company's shares, both of London, that shortly netted them a golden harvest. No, the initial arc lighting of a certain section of the Magazin du Louvre, Paris, frightened them not in the least, and the public lighting by means of arc lamps of the Avenue de l'Opera. This lighting was in force in 1877-78. The spring of 1878 was also notable for the appearance of a small pamphlet entitled "How to Burn Gas," which was intended for gratuitous distribution by gas companies among their consumers. The pamphlet was printed by the publishers of the JOURNAL, and the edition ran into a sale of 100,000 copies. That fraternality was still the watchword was borne out by the formation of the Western Gas Association, St. Louis, Mo., September 18 and 19.

In the summer of 1878 Major Dresser visited Europe, having been commissioned by the Manhattan Gas Light Company, of New York, to make a thorough investigation of the status of the arc lighting industry. On his return he made a lengthy report to his principals, which is given in full in the JOURNAL for October 16, 1878. The concluding sentences of the first paragraph of the report are here given: "The electric light is thus far either a scientific light or a light of luxury. It has special uses, for which it may be well adapted, but GAS is still the light for the millions." While abroad the Major met Mr. Malcolm S. Greenough, Chief Engineer of the Boston (Mass.) Company, and the late Mr. Theobald Forstall, then Engineer of the Chicago Gas Light Company. They had also been charged by their companies with similar investigations, and their reports coincided with that submitted by the Major.

In the December 2 issue appears the first note of recognition of what Mr. Thos. A. Edison was up to in his den at Menlo Park, N. J. It was in the nature of a reprint from the New York *Times*, to the effect that he had been successful in securing an electric light by "Causing a current to pass through a platinum wire, so raising its temperature as to make it self-luminous." The article wound up by advising investors to keep their gas shares. The JOURNAL now was appearing semi-monthly and carried 24 pages. At this time the gas companies were very active in introducing gas cooking stoves, several fairly good specimens of which were on the market, notably those of the "Sun Dial" type, which were manufactured by the Philadelphia meter making establishment of William W. Goodwin & Co. Mr. Goodwin was another whose devotion to the gas industry was not altogether increased or decreased by the moneys that it brought him. The American Meter Company went into this trading extensively, acting first as the agent on this side for the well-known Sugg pattern of English stove, afterward putting on the market a stove of its own manufacture, known as the "Economy," which met with large sales—gas prices had been coming down with frequency the past two years in all sections of the country.

The official titling of the JOURNAL was again changed. A new general heading had been devised, and its wording showed that the words "Chemical Repertory" had been dropped, the new title being "THE AMERICAN GAS LIGHT JOURNAL." This naming first appeared in the issue for February 3, 1879.

Reports of reductions in price were very much in evidence now, and the $2 rate was becoming quite common, so also was the price of kerosene shortening, while the quality thereof was undoubtedly "lengthening." One of the first Eastern companies to reach the $2 mark was the Hartford (Conn.) City Gas Light Company, the selling rate there going to that figure March 1, 1879; and thereafter the General Manager, Mr. John P. Harbison, was an outspoken advocate of lower prices, to secure more trade and greater harmony with the consumers, and to keep out competitors. Not particularly high-sounding "moral effect" reasons, but sound enough to live up to with the expectation of retaining one's healthy business strength. One sign that the policy proved efficacious is that no competing company ever did business in that city, and now the work of Mr. Thomas A. Edison was to startle the artificial lighting art or trade.

Late in the winter of 1879-80 or early in February of the later year the news was spread to the world that Mr. Edison, in his den at Menlo Park, N. J., had succeeded in subdividing the electric current, and that a working example of his invention, consisting of a dozen or more incandescent electric lamps, of 16-candle power each, had been strung along the street in Menlo Park that ran in front of his laboratory to the flight of steps leading down to the Pennsylvania Railroad station. Right at the time Mr. Edison was extremely anxious to secure a complete set of the *Journal of Gas Lighting*, London. That *Journal*, Mr. Edison knew, had at some time published an article concerning the description of a process for the carbonizing of certain vegetable fibres on which he was operating in his search for a suitable filament for his incandescent lamps. He applied to us to secure the English *Journal* complete, provided we knew where such could be obtained in this country. Speed was his desire. He could get the sets from London, but that would use up at least a month. The writer, knowing where such a set could be obtained, visited Menlo Park; the terms were agreed upon, and the books delivered. Nor will he ever forget his reception. Young, quick in action, and filled (absolutely filled) with the belief that the only artificial light that could excel one gas light was another or different gas light, he visited the "Wizard" in his lair, not without trepidation. The laboratory was a low, rambling lot of frame buildings, from the center of which rose a tall iron chimney stack. "No admittance" was the warning on the door, but that sign never interfered with a newspaper reporter. I boldly entered the main door, and then was actually within the working limits of the hive. Scores of men, young and old, were busily engaged in various chemical operations, seemingly in the main of an analytic nature; and prominent in the lot was about as uncouth looking a chap as one ever beheld. That curious looking scientist was Nikola Tesla, then a mere youth, who subsequently startled the world with the results of his studies in wireless telegraphy. However, walking slowly up the aisle (the desks, or frames, or whatever they were, were arranged aisle-fashion) was a man, whose apparel was rather peculiar. He wore a long frock coat and loose trousers; his shirt, which was unbuttoned at the top, was collarless, and round his throat was a silk muffler, loosely tied. His head was covered with a high hat of the silk order. On seeing the writer he quickened his pace and rather brusquely asked if I had not seen the sign. Admitting that I had, the excuse was that I had important business with him personally; that I was not acquainted with the rules, etc. He ushered me into the office. I made known my business, and our barter and sale was concluded. He then took me over the place, explaining many things that caused much wonderment, and introduced me to several of his aides, notably Mr. Telsa, poking quite a bit of fun at me meanwhile. The sun was just going back of the Watchung hills as we started out from the laboratory. Accompanying me down the street, and arriving at the depot stairs, he said: "Now, let me show you something." Stepping to one of the posts surmounted by which was a specimen of the now familiar incandescent lamp bulb, he pressed a device and along the line glowed the entire line of lamps—I think there were 16 in number. It was magical to a certainty. My reply to his query, "What do you think of that?" was simply, "Wonderful." Back to the stairs we went, and while standing there momentarily, I said: "Mr. Edison, one familiar thing to a gas man's eye is missing in this scene." He inquired what is that, and I replied: "The great iron pot that can always be seen in the neighborhood of a gas works—the holder in which the gas man stores his commodity." My foot by then had touched the first step of the depot staircase, and the Wizard of Menlo Park, with outstretched hand, leaned forward as he in low voice remarked, "Gas is a pretty —— good thing after all." The writer saw Mr. Edison once again. It was in the spring of 1881 in the first offices that had been opened by the Edison Company, No. 65 Fifth avenue, New York. At that time his visit was prompted by a desire to secure two incandescent lamps that Major Dresser wished to present to the British Association for the Advancement of Science, the meeting of which body was held that year in Nottingham. These were the first Edison lamps that were sent abroad, and if we mistake not are still in the cabinets of the named society. In June of 1880, the long threatened war for supremacy between the New York City gas companies broke out, which contest was instituted by the action of the Municipal Company invading the territory of the Manhattan Company, despite the agreement made as to districting. All sorts of "net" rates prevailed, and the result was distracting in the extreme. This contest was ended April, 1881, when the price was restored to $2.25 per 1,000.

An important event in the JOURNAL's history occurred with the issuance of the thirty-fifth volume (July 2, 1881), when the name of Charles E. Sanderson appeared officially as Manager of the JOURNAL. From his starting with the paper in 1870, he had been a valuable man on its staff, and his faithfulness in merit and worth were now openly recognized by and through well earned promotion. In effect, though, Mr. Sanderson had been the Manager of the JOURNAL about three months after the death of Mr. Callender. But what is gained here by again reverting to his career, which was told at length so short a time ago? It will likely suffice to here reaffirm that very much of the JOURNAL'S success is definitely traceable to his even ways, and to his judicial methods. Unassuming, but resourceful, the industry of this country owes much to his perseverance and tact. In 1881 the first great electrical exhibition was held in Paris, France, and from that date the real entrance of incandescent electric lighting as an actual, potent, every-day competitor with other forms of artificial lighting, may be dated. It certainly was a brilliant show. However, enough had become known about incandescent electric lighting and its production that gas makers feared it less than they did the arc system, which, costly enough in itself, nevertheless had made its way with great strides in public favor as an illuminator of outdoor territory. At that, New York City proper, in the spring of 1882, was paying $255.50 for each arc lamp maintained in the streets, and in April of that year 1366 arcs were supplied on public account. Toward the close of 1882, or in the fall of that year, great impetus came to the use of gas for cooking. Several types of gas cookers, of modern design, were put on the market, and as universal and pronounced reductions had been made in gas selling rates, the increases in output were very marked. To the cheapening end of the practice the JOURNAL had contributed much good work, and the continued moralizing along this line was decidedly fruitful. In this half of 1882 the States (notably New York) were becoming very busy regulating the sale of mineral oils of all sorts, but, truth to tell, by far the worst competitor of gas then was kerosene, the cheapening of which had been marvelous, and the increase in its sale and use equally so. The gas men, too, were trying to get back some fair portion of the outdoor lighting, and the lighting of large spaces that was lost to them, and about mid year of 1882 came the Siemens system of regenerative lighting, and by the efficient apparatus of a kindred nature which had been invented by Mr. William T. Sugg, of Birmingham, England. In 1882 the Edison Illuminating Company was operating successfully the commercial supply of incandescent lights from a central station in New York City, the station being in Pearl street, and in October of that year current for the maintaining of well over 1500 16-candle-power lamps was being sent out. The work of laying the conduits for the carrying of the first Edison current system to public and private buildings, in the New York City district, bounded by Spruce, Nassau and Wall streets and the East River, was told in the JOURNAL for November 16. In this connection it is noteworthy to report what Mr. Edison said about the worth or value of current as supplied by his Company to ordinary consumers: "Electricity is worth as a commercial product one-third more than gas, and therefore people will use it and pay one-third more for it than they will for gas." The basis of the Edison Company's charge for current was 1 1-16 cents per hour for a 10-candle light. Early in 1883 the downtown Edison station was in good working order, and from the bills rendered to the consumers of the current, as compared with the ruling gas charges, the computation being made on 10-candle values for each unit of light estimated, showed that Edison current was costing the user thereof at least three times more than the gas

user was paying for his illumination. Further, the cost of globes or lamps was a plus factor.

In the issue for February 16, 1883, our section devoted to "Items of Interest from Various Localities," was instituted, and it at once became a valuable feature of the paper. Meanwhile, the forces that had been at work, ever since 1864, quietly, silently and unremittingly, in centralizing the recovery and refining and sale of petroleum oil and its products, had grown to great magnitude and power. The Standard Oil Company was now more than an accomplished fact; it was a tremendous aggregation of power and wealth. The writer will not further mention this corporation, save to say that its influence on the gas industry was in the end rather for good than for ill. And in the cold light of fact, we now presume that it should not as a body be charged with the rapacities laid to its door, through the cruel activities of some of those who helped to make its history. It is not an institution over which the writer proposes to place the anchor or the cross or the wreath; but individual acts of the members—and some of these violated every bond of commercial honor. Witness the way in which control of the Williamsburgh Gas Light Company, of Brooklyn, N. Y., was obtained! However, that is all dead news now, and its exhuming will serve no useful purpose. Take it all in all, though, all the results achieved by the Standard Company were not bad. In connection with this matter the reader will find much to interest him in this respect if he reads the famous articles on this company that were originally prepared for the *North American Review,* January, 1883, which articles (they were respectively from the pens of U. S. Senator J. N. Camden and Mr. John C. Welch) were republished by us February 16, 1883. The war against water gas was now in fullest cry, and the heartburnings of those days were many and severe. Actually families were parted by its waging. But the triumph of those who advocated it was certain to come; what with the finest grades of enriching naphtha at less than 2 cents per gallon! Selah! The extinguisher of active opposition to the gas *per se* and the often raw and raucous ways followed by many interested in its "development," however, was the electric current. Gas men, in the face of this giant young disturber, along about this time were asking each other if their combating were worth the candle, and let it be told right here and now that the JOURNAL'S change of base was occasioned by this very electric invasion. Gas men were the JOURNAL'S men, which was as it should have been. For who were its very supporters? The year 1883 was also famous in gas for the appearance in the JOURNAL of a series of articles on "The Management of Small Gas Works," by Mr. C. J. R. Humphreys, who was then managing the small plant of the Bayonne and Greenville Gas Company, of Bayonne, N. J., and who has since become famous as a gas engineer, with merit and value of the highest type. These articles were subsequently reprinted by us in book form, and ran through three editions. At this time the United Gas Improvement Company was working its way to the front, and many a sore spot is traceable to its pounding. It was the forerunner of the "Parent" or "Operating" companies in this country, and was likely framed from some of the European prototypes. Nothing of good can be gained by any recriminating here, and as out of evil good may come, we believe we are not wide of the truth when we say that its "progressive and aggressive" young engineers of a quarter century ago are the progressive and finished gas engineers of to-day. The club is laid away forever, and its successor is fair argument. The growth of this company, too, was best promoted through the expanse of peace.

Again was the JOURNAL to suffer through the hand of death. On his return from his second European voyage (the summer of 1882), Major Dresser complained much about trouble with his teeth, and although the best of treatment had been accorded him, it was not to be denied that his lower jaw had been attacked by necrosis. For long and weary months he suffered only as a hero suffers; but the disease progressed and its fatal termination came to hand the afternoon of Sunday, May 27th, at Newport, R. I., to which city (the home of his estimable wife, whose death preceded his only a few weeks) he had been removed the prior- March To many present-day engineers he was well known. Nor may it serve any useful purpose to here debate upon him. Having said that he was a worthy son, an attentive student, a brave soldier, an accomplished engineer, an affectionate husband and father and a noble friend, all is said that could be said. On July 2, 1883, Colonel Joseph R. Thomas officially succeeded to the title of Editor; but he had been virtually such since the preceding April, in which month he resigned from the position of Chief Engineer to the Williamsburgh Gas Light Company, Brooklyn, N. Y. To show the kind of man he was, it is noted here that he refused to continue as Engineer to the company (and the position was one that commanded a salary well up in the thousands), owing to the methods of the capitalists who had a short time earlier succeeded in getting control of its capital. That was the nature of the man.

The JOURNAL, through its sturdiness and uniformity in standing for principle as it beheld such, kept gaining ground steadily. Its patronage broadened, for every one in the gas business knew that its advocacy of any cause, or its support of any particular line of action was from sheer belief in the justice and wisdom of these. Of course, it made enemies, and powerful ones some of them were, nor did they slight thought or work in their endeavors to punish it for its independence.

In these days the gas industry grew with amazing swiftness. Prices were lowering constantly, processes of manufacture and distribution were being all the time perfected. But there was to be another struggle, not a general one, but of a sporadic nature, or wherever natural gas was found. The limits of the field of this newcomer were unknown. Wells spouting millions upon millions of gas were reported with frequency; but its advent, owing to the finding of the sources rather remote from centers of population, save in the instance of Pittsburg, Pa., curtailed its applicability. In that center of the coal and iron industry, however, processes and ways of working were revolutionized and the artificial gas men then became in time distributors of the natural article. But of the history of this, no particular mention may be made here, for it is still with us, and is well known to us, and has taught us, is teaching us, much. To its advent, only second in power to the cheapening of artificial gas, is due the wonderful strides that have been made in the last 20 years in the instance of the use of gas as fuel. This product of nature did yeoman's work in this respect in New York, Pennsylvania, Ohio, Indiana, Illinois and Kansas, and the Virginias as well; in fact, scarcely a State has missed it in some shape; although its wane in Indiana, Pennsylvania, and sections of other States is marked, the kerosene market still remained, however, the most potent menace to the artificial gas maker. In pursuance of its policy of going on with the times, the JOURNAL was fortunate enough to secure the services of a special English correspondent in the person of Mr. Norton H. Humphrys, of Salisbury, England. His first letter appeared in the JOURNAL for April 2, 1884, and it has appeared once each month since. We need not say anything about the interestingness of the correspondence, which has always been newsy, trenchant and meritorious. Further as a gas manager and engineer, Mr. Humphrys is held in high honor in his own land.

The paper grew materially in the period now under review, and its makeup increased to an average of 32 pages. Its advertising was typical of the growth of the industry since it listed to the attention of the gas manager many things that were unthought of 10 years before. The associations were increasing in numbers and prosperity and the spirit of fraternality was becoming pronounced. Toward the close of 1885 the gas industry was beginning to feel the combined pushing of kerosene and electric lighting competition, and companies were constantly experimenting with burners, and several types of high illuminating power burners, both in England and America, were brought out.

The JOURNAL for May 17, 1886, however, reprinted from the columns of the leading French engineering periodical (*La Revue Industrielle*) an illustrated description of a burner which was being developed by Dr. Auer von Welsbach. It was of the incandescence type, and the inventor had been concerned with it for three years or more. At the time noted above, however, the Doctor announced that he had perfected it, and it was ready for the market. That is just a trifle over 23 years ago; but to look at the burner of 1886 and at that of 1909, the comparison reveals vast differences in favor of the latter. However, the crux of it all was there—the mantle; so was the principle of its working. It was frowned on in this country first; in fact, the JOURNAL decidedly decried it. But the force of fact soon caused us to retract our speech against it, to go on record at once and again as its most outspoken advocate. But these recantations are not of necessity now, for to-day it is in the fullest glow of success. But think of what that meant then! A 12-fold increase of illuminative effect with a decrease of 50 per cent. in the gas used to obtain the greater volume. With this weapon in their hands, the gas industry went in once more for ordinary lighting of all sorts, even to the reclaiming of street lighting. That this has been done, the records of every populous place in America show, even unto the displacing of arc electric lighting.

The inventor has been honored by his fellow-men in many ways; and, best of all, he lived to see the great work that was accomplished by the use of his device. We can say nothing further about it at this time, since everywhere one can turn, there he is confronted with the mantle of Dr. Auer. Now also was the acceptance by many, who hitherto opposed the thought, of the possibility that good could come from the establishment of State Gas Commissions, and Massachusetts led the way. Truly, she led well; for in no other State of the Union have gas investments been more stable than those of the Bay State; nor has that commission been inimical or harmful in any sense to the consumer. In any event, many other States are having a try at it just now, notably New York. The JOURNAL has contended for this principle for 30 years or more, and is now more convinced than ever that supervision by commission is the best way out of the danger of meeting disaster at the hands of the people's average lawmakers.

The JOURNAL in 1887 had expanded to 32 pages, and the work of conducting it went along smoothly, harmoniously and successfully. The rate reductions, however, in New York City, now that the companies had a pretty good understanding as to districts and the like, were not to the point that could keep outsiders from getting in, and the Equitable was the latest of these. Another notable thing was that the gas companies and the electric lighting companies were often joining forces, to the end that the joint supply could be economically administered.

The next important change in the JOURNAL'S career occurred January 7, 1889, on which date it appeared for the first time as a weekly publication, and the announcement was made that Thomas J. Cunningham had been appointed Editorial Assistant to Mr. Thomas. It is also worthy of mentioning that no change was made in either subscription price or rates for advertising, which decision was not altogether well received by our contemporaries. The size of the JOURNAL, rather its bulk between covers, went on to 36 pages. In the issue for January 14, 1889, appears a splendidly illustrated article on the new holder which had been put in service the previous November by the Consolidated Gas Company, of New York City—this corporation had quite some time before been formed by the union of the New York, Manhattan, Metropolitan, Municipal, Knickerbocker and Harlem Companies, with General Charles Roome as President. This holder was of the triple-section type, rested in a steel tank and was rated to store 3,300,000 cubic feet, and was looked upon with quite some respect as a leviathan; but compare it with the one now in use over at the Astoria plant of the Consolidated Company, which is rated to store something over 15 millions cubic feet—this thing alone will give some idea of the progress in the gas industry in the last 20 years.

In the concluding paragraphs of this history lesser mention will be made of the livelier topics of the current moment, since we have brought these to within a score of years, the history whereof of any special matter is easily obtainable. Confining ourselves, then, to the matters affecting the JOURNAL exclusively, a change in its habitation was announced in the issue dated April 27, 1891, which informed the industry that thereafter its headquarters would be in 32 Pine Street. The change was an obligatory one, for the structure at 42 was at once dismantled to make way for a modern office structure. Here its prosperity continued, and likely many of our readers well remember the circumstance that adjoining our offices were those of that well-loved gas man, Captain William Henry White. Here followed a long era of success in the industry. The electric light was justly appreciated as filling a peculiar field, and the spread of the use of gas for cooking purposes was phenomenal. Association work had broken down completely the last barriers of reserve and everything made for harmony and development. The production of gas was being done at lower cost all the while, and rates were being constantly cut. The JOURNAL meanwhile went on its way, enjoying the confidence and support of the industry, which was again becoming the scene of combination by purchase for operation on parent company account. Smoothness marked our pathway until the close of November, 1896, when the news of the death of Colonel Thomas reached us. For months he suffered from a disease that would not yield to any treatment, and the end came at his home, in Glen Ridge, New Jersey, the evening of Saturday, November 28. The story of his life is told elsewhere in this number, but the writer would surely be remiss did he not here pay the greatest token that in him lies to the memory of his last chief. A noble man the latter was. Grounded in the faith that this world was not the end of it all, he lived accordingly. Not a narrow, book-taught way did his path wear. He had rectitude in his dealings with others as a main guide and the markings which line it were those of charity of mind, charity of deed. However, his time on earth was far beyond that which ordinarily comes to man; and in that period he left little undone that he should have done, and the writer believes he makes no mistake in saying, that no better equipped engineer of his day and time lived. During his control of the editorial direction of the paper, even though it was his constant practice to speak direct and to the point, the writer has not the slightest doubt that those who differed from him most vitally on any or all points, were his strongest respecters in the end.

The January first issue of the paper contained the announcement that the editorship of the JOURNAL had devolved upon Mr. Thomas J. Cunningham and Mr. Elbert P. Callender, and under that direction it still remains. Mr. Elbert P. Callender is a son of the late Mills L. Callender.

The business at large continued to grow, despite interferences, now mainly by legislation, for between 1897 and now, many wrongs have been done to the industry through hostile legislation, the initial prompting of which had little care or thought for the bettering of the consumer. As witness the act that put the gas rate in New York at 80 cents per 1,000. Still we presume that must now be considered a blessing, in that the United States Supreme Court has declared it a just and righteous measure, which is but another instance that blessings are sometimes disguised.

In 1897 the JOURNAL was increased to 40 pages, between which number and 48 pages it has since been sent to its readers. As before, our way was that of success, and with the prosperity of the industry, we prospered. The era of good will, brought about undoubtedly in good measure by the teachings of the JOURNAL, increased day by day. Competition of the opposition sort was very little now in evidence, but combination by purchase was the course pursued; and the acquiring of electric companies by gas companies, and vice versa, was of frequent occurrence. No doubt, the Auer lamp had much to do with this. Uneventfully, the years now passed on, if evenness in progress means uneventfulness. The march of the skyscraper again disturbed our peacefulness, for early in 1902 the Hoyt Estate parted with its real estate holdings, and the purchasers of course bought the site with the view of uprearing another of those aerial castles for which New York is now so famous. The opportunity offering, we secured suitable accommodations in 42 Pine Street, once more, where we have since been domiciled.

Soon again we were to feel the summons of death. This time the call was for Mr. Charles E. Sanderson, whose demise ended an illness that he fought against for quite well over 6 years. He answered the summons the afternoon of February 20th, 1907, in the 61st year of his age. His death terminated an active, unbroken business connection that covered a stretch of a trifle over 37 years as a man and manager. Liked by all who knew him, even in trading and true in promise, his conservative career as Manager of the JOURNAL tided it over many turmoils, some of which momentarily threatened its welfare. On January 1, 1909, Mr. Charles H. Wadelton was appointed Manager, although he has been on the business staff since January, 1908. He brings to the office a well trained business mind, having resigned from the service of one of the largest corporations in this State—which he served capably for several years—to accept this position.

And this brings us down to the current time, at least as far as the history or chronological record of the JOURNAL goes. The writer desires to here say, after the manner of Vale! that he has been with the JOURNAL since May 1st, 1870, first as printer's devil, then as compositor, now as editor. During that time he was the student under Callender, Wurtz, Dresser and Thomas, and the privileged associate of many of the greatest engineers of their time—notably the lamented Eugene Vanderpool, who was in his day easily the dean of his profession; George A. McIlhenny, C. Vandervoort Smith, W. H. Bradley, A. M. Smith, A. Hite Barret, Frederic Egner, C. J. R. Humphreys—but a stop must be made here, or else one could hardly stop. To those men he owes much from, of and through their counselling and advice, and to all of them he acknowledges his indebtedness. As an evidence of the recognition by the proprietors of the generous patronage that has been afforded them, this semi-centennial issue of the JOURNAL is respectfully dedicated.—THOS. J. CUNNINGHAM.

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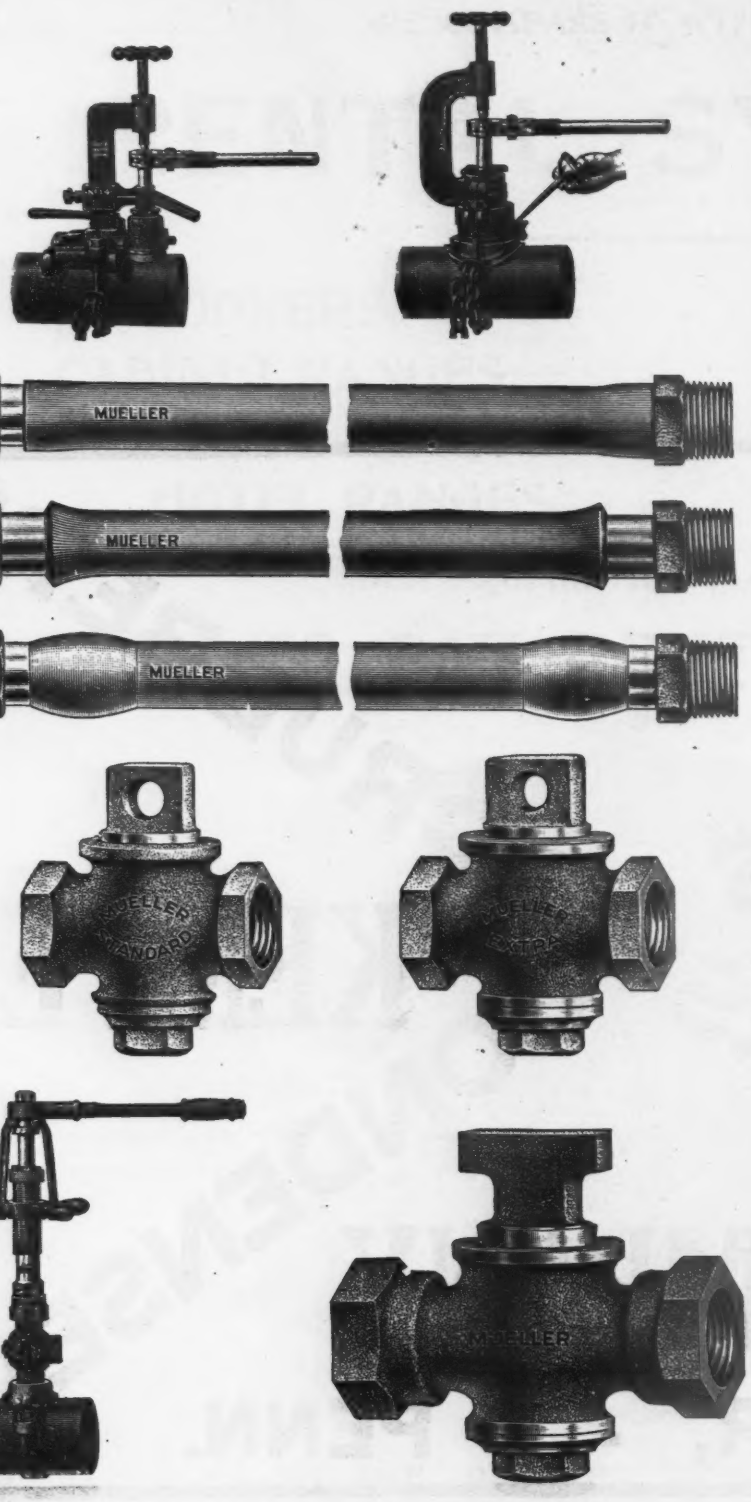

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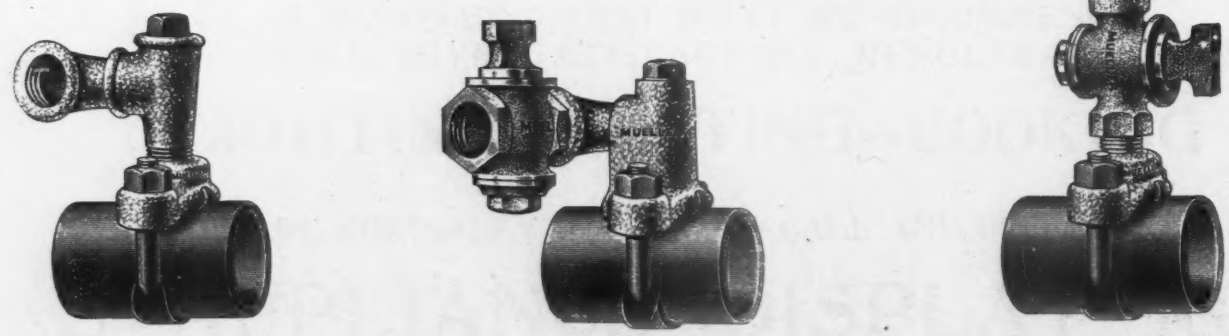

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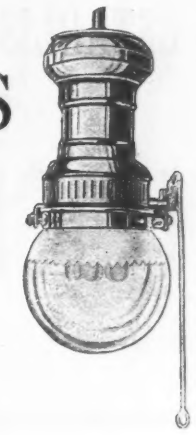

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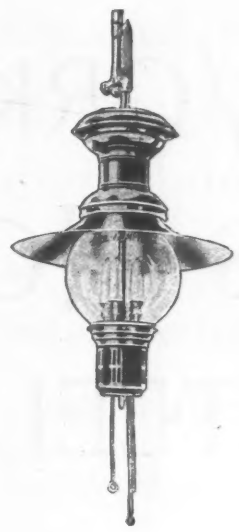

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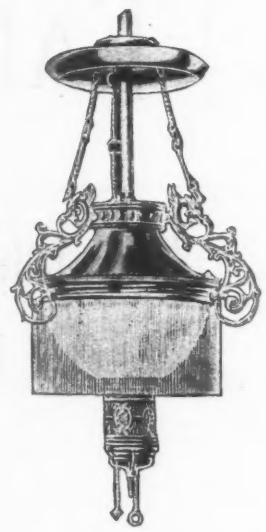

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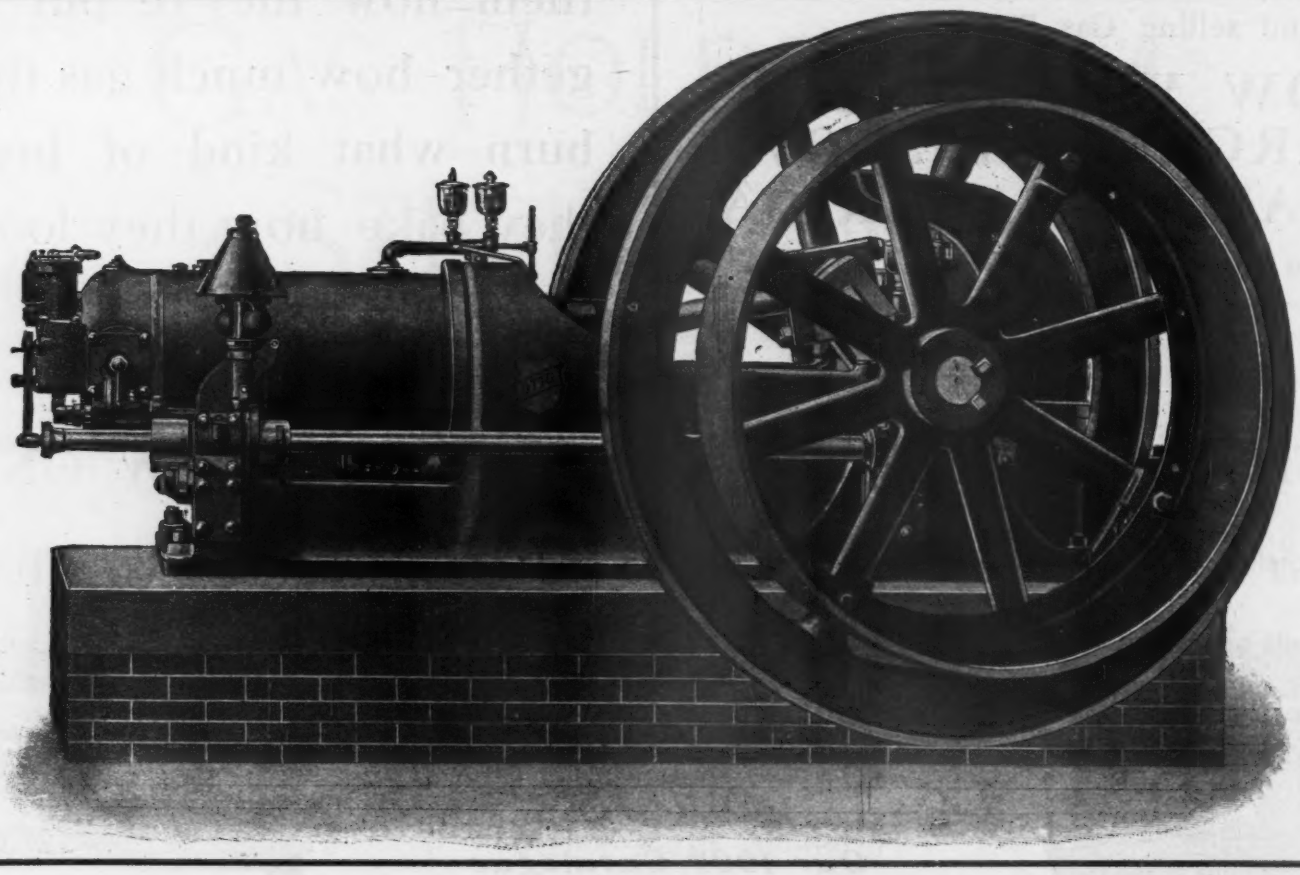

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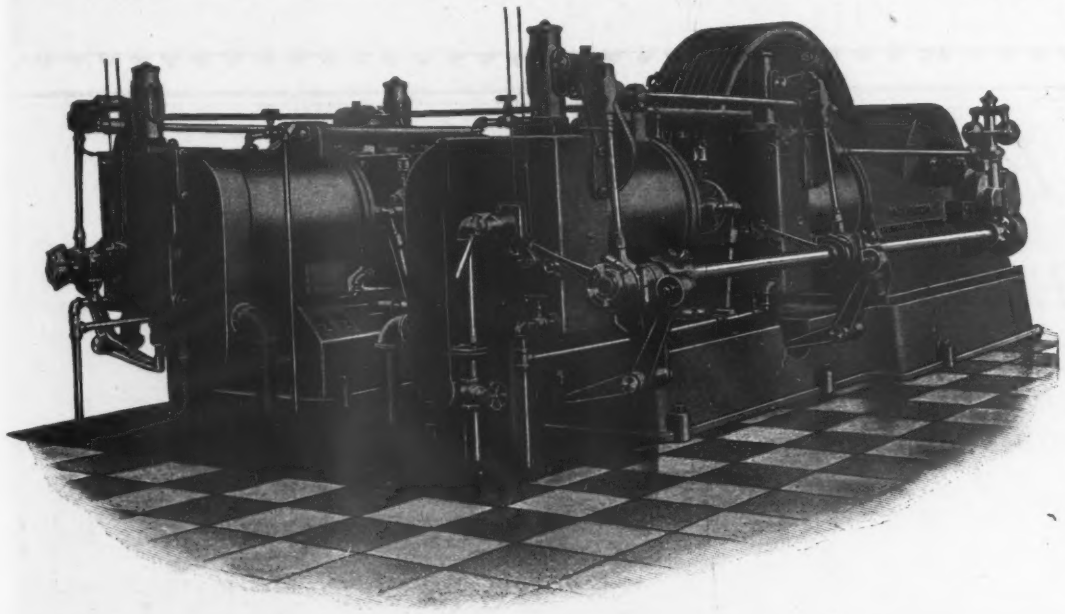

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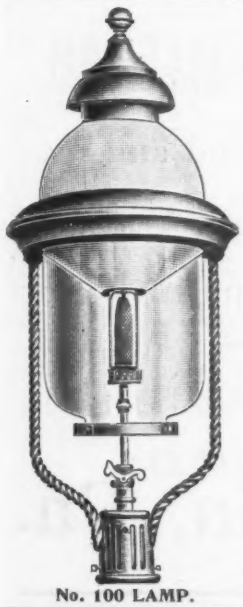

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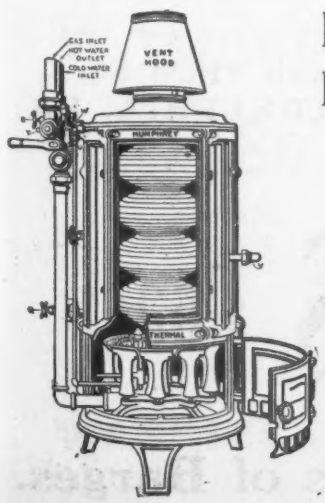

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